

The presupposition of *even**

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Abstract I present a new observation with regard to the felicity of using *even*: there is no apparent focus/QUD congruence for *even*-sentences. For example, *even Mary_F came* cannot be used to answer a question like *who came* or *who was unlikely to come*. Instead, the felicitous use of *even Mary_F came* is to address issues like *how successful the exhibition was*, *how enthusiastic people were*, *how urgent the matter was*, etc. Thus I propose that the use of *even* is QUD-sensitive, always with regard to a contextually salient degree question. *Even* brings a degree-based presupposition of additivity, not an entity-based one (see also Greenberg 2018 for a similar view). An *even*-sentence presupposes that its prejacent is associated with a degree value, a benchmark value higher than the usual contextual threshold, resolving a degree question with an increasingly positive answer. E.g., under a relevant scenario about how popular a certain talk was, *even Mary_F came* is roughly interpreted as *(the talk was so popular) that Mary_F came*. Under the current analysis, the entity-based additivity and likelihood-based scalarity of *even*, which are considered presuppositions under the traditional view, are now considered implicatures.

Keywords: *even*, presupposition, question under discussion (QUD), degree question, degree semantics, additivity, likelihood, gradable predicate, scale, interval, informativeness

1 Introduction: the canonical analysis of *even* and its problems

According to the classical view (e.g., Karttunen & Peters 1979), the use of *even* has two presuppositions: **entity-based additivity** and **likelihood-based scalarity**.

As illustrated in (1), the use of *even* is focus-sensitive, and the word *Mary* bears focus here. Both the positive and negative version of (1) convey the presuppositional meaning that someone other than *Mary* came. This presupposed additivity is directly based on the alternative set of the focused item *Mary* and thus dubbed as **entity-based additivity** in this paper.

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Both the positive and negative version of (1) also have the meaning that compared to others, Mary was relatively unlikely to come. In other words, the alternative set of Mary is considered ordered along a scale of likelihood (i.e., how likely it is for x , a member of the alternative set of Mary, to make ‘come(x)’ hold true), and thus the use of *even* involves a **presupposition of likelihood-based scalarity**.

- (1) (It’s not the case that) even [Mary]_F came.
- a. **Presupposition of entity-based additivity:**
(1) \rightsquigarrow Someone other than Mary came.
 - b. **Presupposition of likelihood-based scalarity:**
(1) \rightsquigarrow Compared to others, Mary was unlikely to come.

This entity-based additivity (see (1a)) is actually somewhat soft and not necessarily satisfied in felicitous uses of *even*. For example, Szabolcsi (2017: 458, (10)) shows that under the given scenario in (2), the use of *even* in (2a) is perfectly natural, although the presuppositional requirement of additivity is not met, because Eeyore was the only one who took a bite of thistles and spit them out.

- (2) **Scenario:** Imagine Pooh and friends coming upon a bush of thistles. Eeyore (known to favor thistles) takes a bite but spits it out.
- a. Those thistles must be really prickly! Even [Eeyore]_F spit them out!
((2a) $\not\rightsquigarrow$ Someone other than Eeyore spit thistles out.)

It has been pointed out that the likelihood-based presupposition of *even* (see (1b)) also encounters empirical challenges: a low likelihood is neither a necessary nor a sufficient condition for felicitous uses of *even*.

As illustrated in (3) (from Rullmann 1997: 56, (45)), given that John is a political non-conformist, compared to other reading materials, it’s not necessarily less likely for him to read a banned book. Similarly, in the example (4) (from Greenberg 2016: 6, (15)), the use of *even* does not convey the meaning that it is less likely for a tool to be made of steel than to be made of strong aluminum. These examples show that a low likelihood is not always necessary in felicitous uses of *even* (similar examples can also be found in Herburger 2000; Gast & Van der Auwera 2011, a.o.).

- (3) John is a political non-conformist. He even read [*Manufacturing Consent*]_F although it has been banned by the censorship committee. (Rullmann 1997)
- (4) Seller to client: Both tools are strong. The one on the right is made of strong aluminum, and the one of the left is even made of [steel]_F. (Greenberg 2016)

On the other hand, as pointed out by Greenberg (2016, 2018), it is infelicitous to use *even* in the example (5). In this case, the proposition *the blue box has apples*

asymmetrically entails the proposition *the blue box has fruits*. Thus the likelihood of the former is guaranteed to be lower than that of the latter, with focus alternative *fruits* to replace *apples*. Nevertheless, the use of *even* is weird in (5), suggesting that a low likelihood is actually insufficient for felicitous uses of *even*.

- (5) The red box has fruits. The blue one (#*even*) has [apples]_F in it. (Greenberg 2016: 19, (41))

Based on these observations, Greenberg (2018) challenges the classical likelihood-based analysis of *even* (see (1)) and proposes a new gradability-based account.

In this paper, I will provide a new observation on how to use *even* felicitously (Section 2). Essentially, I show that an *even*-sentence is never about its focused part. Instead, it's a contextually salient degree-related QUD (Question under discussion) that an *even*-sentence addresses. Then I will provide a new degree-QUD-based analysis for *even* (Section 3) and compare my new proposal with Greenberg (2018) (Section 4). Finally, I will address remaining issues for further research (Section 5).

2 A new observation in light of focus/QUD congruence

Here I show that *even* is distinct from other focus-sensitive particles like *only* and *also* with regard to patterns of focus/QUD congruence (see Roberts 2012, a.o.).

As illustrated in (6), the declarative sentence (6a) contains focus-sensitive particle *only*, and *Eeyore* bears focus here. Intuitively, (6a) tells us whether Eeyore spit thistles out and whether there exists someone else that spit thistles out. In other words, (6a) addresses an overarching QUD like *who spit out thistles* (see (6b)), which, as expected, corresponds to the focused part in (6a). Given an implicit or explicit question *who spit out thistles*, we can use (6a) as a felicitous answer to it.

- (6) a. Only [Eeyore]_F spit thistles out.
 \leadsto Eeyore spit thistles out, and no one other than Eeyore spit them out.
 b. (6a) corresponds to the QUD: Who spit out thistles?

Similarly, as shown in (7), here the declarative sentence (7a) contains focus-sensitive particle *also*, and again, the word *Eeyore* bears focus. Intuitively, (7a) is also about whether Eeyore as well as someone else spit thistles out, i.e., (7a) also addresses an overarching QUD like *who spit out thistles* (see (7b)). As expected, this QUD corresponds to the focused part in (7a).

- (7) a. (Pooh spit thistles out.) [Eeyore]_F also spit thistles out.
 \leadsto Eeyore spit thistles out, and someone else spit them out.
 b. (7a) corresponds to the QUD: Who spit out thistles?

The upshot here is that for sentences containing *only* and *also*, there is a natural correspondence between the focused part in these sentences (e.g., *Eeyore* in (6a) and (7a)) and a QUD that targets this focused part (e.g., the *who* question shown in (6b) and (7b)). Thus focus/QUD congruence holds for felicitous *only/also*-sentences.

Intriguingly, this pattern of focus/QUD congruence does not hold for *even*-sentences. Under the previous scenario with regard to Pooh and friends' coming upon a bush of thistles, if we (implicitly or explicitly) wonder **who spit out thistles** (i.e., without the likelihood component) or **who was unlikely to spit out thistles** (i.e., with the likelihood component), it is weird to use the *even*-sentence with focus on *Eeyore*, (8c), as a felicitous answer.

- (8) **Scenario:** Imagine Pooh and friends coming upon a bush of thistles. We wonder **who takes a bite of thistles and spits them out**.
- a. QUD: Who spit out thistles?
 - b. QUD: Who was unlikely to spit out thistles?
 - c. #Even [*Eeyore*]_F spit thistles out! Not a good answer to (8a) or (8b)!

However, if, instead, we (implicitly or explicitly) wonder **how prickly those thistles are**, then the same *even*-sentence with focus on *Eeyore*, (9c) (=8c), can be used as a felicitous answer to this kind of degree(-related) question.

- (9) **Scenario:** Imagine Pooh and friends coming upon a bush of thistles. We wonder **how prickly those thistles are**.
- a. QUD: How prickly are those thistles?
 - b. QUD: Are those thistles prickly?
 - c. Even [*Eeyore*]_F spit thistles out! A good answer to (9a) or (9b)

To sum up our observations from (8) and (9), although in the *even*-sentence (8c)/(9c), it is *Eeyore* that bears focus, a good QUD to which this *even*-sentence is a felicitous answer, is not about this focused part, but instead a degree question.

The examples shown in (10) and (11) make the same point. Under the scenario in (10), we wonder **how tall Bill is**. Evidently, the focused part in (10c), *6 feet*, provides information on the height of Bill. However, with the use of *even*, no matter whether we include the likelihood component or not (see (10a) vs. (10b)), (10c) is intuitively infelicitous to be used as an answer to this kind of *how-tall* question.

- (10) **Scenario:** We wonder **how tall Bill is**.
- a. QUD: How tall is Bill?
 - b. QUD: How tall is Bill unlikely to be?
 - c. #Bill is even [*6 feet*]_F tall. Not a good answer to (10a) or (10b)!

However, once we shift our interest from the height of Bill to his eligibility of joining the tennis team (see the scenario in (11)), the same *even*-containing sentence with focus on *6 feet* becomes felicitous.

- (11) **Scenario:** Only boys as tall as 5'8" are eligible to join the tennis team. We wonder **whether Bill is tall enough to be eligible**.
- a. QUD: How is Bill's eligibility?
 - b. QUD: Is Bill tall enough to join the tennis team?
 - c. Bill is even [6 feet]_F tall. A good answer to (11a) or (11b)

The contrast between (10) and (11) shows again that, for an *even*-sentence, the pattern of focus/QUD congruence is distinct from the pattern for *only/also*-sentences. An *even*-sentence does not address a QUD that targets the focused part of the *even*-sentence. By including *even* in the sentence and uttering *Bill is even [6 feet]_F tall* (see (10c)/(11c)), interlocutors do not really show an interest in the height information of Bill, but rather how this height information of Bill helps to resolve the issue of how Bill is eligible for joining the tennis team.

Therefore, the generalization is that (i) the use of an *even*-sentence in a discourse is to address a degree-related QUD, and (ii) this degree-related QUD is not about the focused part in the *even*-sentence per se, but rather about another contextually salient issue which the information provided by the focused part contributes to resolve. In (9), *even [Eeyore]_F spit thistles out* indicates that those thistles are very prickly, reaching a degree higher than usual. In (11), *Bill is even [6 feet]_F tall* indicates that, in terms of height, Bill's eligibility is higher than required.

In this sense, *even*-sentences can often be roughly paraphrased with the use of the 'so ... that' construction, as shown in (12) and (13). Obviously, both the positive and negative version of (13) convey the meaning that Mary's coming indicates a high degree of success, enthusiasm, urgency, etc. While the positive version of (13) asserts the truth of the prejacent and thus further means that this high degree (of success, etc.) is reached, the negative version of (13) suggests the contrary.

- (12) **Scenario:** Imagine Pooh and friends coming upon a bush of thistles. Eeyore (known to favor thistles) takes a bite but spits it out.
- a. Even [Eeyore]_F spit them out!
≈ Those thistles are so prickly that [Eeyore]_F spit them out.
- (13) (It's not the case that) even [Mary]_F came. (Prejacent: *Mary came.*)

The exhibition was (not) so successful
 People were (not) so enthusiastic
 The matter was (not) so urgent

} to the degree that [Mary]_F came.

3 Proposal

As presented in Section 2, in the example about the prickly thistles (that Eeyore spit out) (see (9)), the *even*-sentence, *even* [Eeyore]_F spit thistles out, emphasizes the high degree of prickliness of the thistles. In the examples (11) and (13), the *even*-sentences, *Bill is even* [6 feet]_F tall and *Even* [Mary]_F came, express an intensified degree of eligibility, success, enthusiasm, urgency, etc. In this sense, the semantic contribution of *even* involves **degree-based additivity**, **not entity-based additivity** (cf. entity-based focus particles like *only* and *also*, see (6) and (7)).

Thus, I propose that the major semantic contribution of *even* is to make its prejacent contribute information to resolve a contextually salient degree-related QUD (i.e., an implicit or explicit degree question), leading to an increase from a usual contextual threshold to a higher value, and thus resolving the degree QUD with an increasingly positive answer.

The presupposition of a sentence of the form ‘*even*(*p*)’ includes two parts: (i) the prejacent *p* provides information to resolve a degree QUD, and (ii) *p* is maximally informative, as informative as any of its alternatives in resolving this degree QUD.

The formal implementation of this basic idea involves (i) how to associate the information provided by a proposition *p* with the information needed to resolve a degree QUD and (ii) how to represent and compare informativeness. Below I first address these two issues and then assemble them into a formal analysis of *even*.

Associating *p* with the resolution of a degree QUD. Inspired by previous literature on the semantics of degree modifiers like *enough*, *too*, and *so* (... *that*) (see Meier 2003; Hacquard 2005, 2006; Nadathur 2019), I assume that for *even*-sentences, there is also a hidden conditional relating two propositions.

As illustrated by (14), with the use of *enough* and *so* (... *that*), the prickliness degree of the thistles informs on whether Eeyore spit them out. Then as illustrated by (15), intuitively, an *even*-sentence is interpreted like a backtracking conditional: the truth of the prejacent of *even* (here *Eeyore spit out thistles*) informs on the prickliness degree of the thistles.

- (14) a. The thistles were prickly enough for [Eeyore]_F to spit out.
 b. The thistles were so prickly that [Eeyore]_F spit them out.
 (14a)/(14b) \approx If the thistles reach the degree *d* in terms of prickliness, then Eeyore spit them out (see Meier 2003).
- (15) (The thistles must be really prickly.) Even [Eeyore]_F spit them out.
 (15) \approx If (we know that) Eeyore spit the thistles out, then (we know that) they must reach the degree *d* in terms of prickliness.

The presupposition of *even*

Based on this, I use a necessity modal (see Kratzer 1981, 1991) to relate p (i.e., the prejacent of ‘*even(p)*’) and the degree information for resolving a degree QUD. If p is true, then it follows that the QUD *how* G_{qud} *is* x_{qud} is informatively addressed, yielding a positive answer: x_{qud} *is* G_{qud} (i.e., x_{qud} reaches the contextual standard d_{std} along the scale of G_{qud}). As sketched out in (16) (to be revised), for each world w' accessible from the reference world w ,¹ if p holds true in w' , then the measurement of x_{qud} along the scale G_{qud} in w' reaches the standard degree d_{std} .

- (16) Associating the prejacent p with the resolution of a degree QUD *how* G_{qud} *is* x_{qud} :
 $\forall w' \in \text{Acc}(w)[p(w') \rightarrow G_{qud}(x_{qud})(w') \geq d_{std}]$
 i.e., Every p -world is a world where the measurement of x_{qud} along the scale G_{qud} reaches the standard degree d_{std} .
 (G_{qud} is a measure function of type $\langle e, \langle s, d \rangle \rangle$, which is to be revised soon.)

Representing and comparing the informativeness of a scalar value. To represent and compare informativeness of degree-related information, I follow previous literature on degree semantics (Schwarzchild & Wilkinson 2002; Abrusán 2014; Zhang 2020; Zhang & Ling 2015, 2021) and adopt the notion of **intervals** to represent scalar values in a more generalized way. An interval is a convex set of degrees, e.g., $\{d \mid 15'' < d \leq 20''\}$, which can also be written as $(15'', 20'']$.²

As shown in (17), a gradable adjective like $[[\text{tall}]]^w$ relates an interval I and an atomic individual x , such that the height measurement of x in world w falls within the interval I along a scale of height. Thus, as illustrated in (18), the semantics of a measurement sentence is derived straightforwardly. Obviously, given that the interval $[18'', 18'']$ is a proper subset of the interval $[15'', 20'']$ (i.e., $[18'', 18''] \subset [15'', 20'']$), (18b) is more informative on the height of Eeyore than (18a).

- (17) $[[\text{tall}]]^w \stackrel{\text{def}}{=} \lambda I_{\langle dt \rangle} . \lambda x_e . \text{Height}_{\langle e, \langle s, dt \rangle \rangle}(x)(w) \subseteq I$
 (i.e., the height measurement of x in w falls within the interval I .)
 (Here Height is a measure function of type $\langle e, \langle s, dt \rangle \rangle$.)
- (18) a. $[[\text{Eeyore is between 15 and 20 inches tall}]]^w$
 $\Leftrightarrow \text{Height}(\text{Eeyore})(w) \subseteq [15'', 20'']$ **Measurement sentence**
- b. $[[\text{Eeyore is exactly 18 inches tall}]]^w$
 $\Leftrightarrow \text{Height}(\text{Eeyore})(w) \subseteq [18'', 18'']$ (I : a singleton set of degrees.)

1 In interpreting *even Mary_F came*, we don’t want to include those worlds very different from the reference world, e.g., a world where Mary was kidnapped to an unsuccessful exhibition.

2 A totally ordered set P is convex iff for any elements a and b in the set P (suppose $a \leq b$), any element x such that $a \leq x \leq b$ is also in the set P . In interval notation, square brackets are used to represent **closed** lower/upper bounds, while round parentheses are used to represent **open** lower/upper bounds.

For the positive use of gradable adjectives, as illustrated in (19), $[d_{\text{std}}, +\infty)$, an interval with the contextual threshold degree, d_{std} , as the lower bound, serves as the interval argument of $\llbracket \text{tall} \rrbracket^w$. (19) means that the height measurement of Brienne reaches the contextual threshold of being tall (for a relevant comparison class, e.g., as a woman, or as a knight).

$$(19) \quad \llbracket \text{Brienne is tall} \rrbracket^w \Leftrightarrow \text{Height}(\text{Brienne})(w) \subseteq [d_{\text{std}}, +\infty) \quad \text{Positive use}$$

With this interval-based degree semantics for gradable adjectives, I adopt the categorial approach to questions (see Hausser & Zaefferer 1978 and Krifka 2011 for a review) and analyze a degree question as a set of intervals, as shown in (20). Essentially, this set of intervals includes all possible intervals I that make ‘ $\text{Height}(\text{Brienne})(w) \subseteq I$ ’ hold true, which is in the same spirit as Hamblin (1973): a *wh*-question denotes the set of all its possible answers. Hamblin (1973)’s set is a set of propositional answers, while I follow the categorial approach and consider a set of short answers (also called fragment answers) in this paper.

$$(20) \quad \llbracket \text{How tall is Brienne} \rrbracket^w = \lambda I. \text{Height}(\text{Brienne})(w) \subseteq I$$

Then as shown in (21), the operator Max_{info} takes a set of intervals and returns the unique maximally informative one. The proposal of this Max_{info} operator follows the same spirit as Dayal (1996)’s answerhood operator, which presupposes the existence of a maximally informative true answer to a *wh*-question and picks out this maximally informative true answer from the set of all possible answers. Obviously, when Max_{info} is applied onto a degree question (see the set of intervals in (20)), the output is the most informative interval that resolves this degree question. For a question like $\llbracket \text{how tall is Brienne} \rrbracket^w$, ‘ $\text{Max}_{\text{info}}[\lambda I. \text{Height}(\text{Brienne})(w) \subseteq I]$ ’ yields the singleton set of degrees that stands for the precise height measurement of Brienne in the reference world, e.g., $[6'3'', 6'3'']$ (suppose the measurement is ideal and does not involve any measurement imprecision).

$$(21) \quad \text{Max}_{\text{info}}\langle\langle dt, t \rangle, \langle dt \rangle\rangle \stackrel{\text{def}}{=} \lambda p_{\langle dt, t \rangle}. \mathbf{1}I[p(I) \wedge \forall I'[[p(I') \wedge I' \neq I] \rightarrow I \subset I']]$$

(defined when $\exists I[p(I) \wedge \forall I'[[p(I') \wedge I' \neq I] \rightarrow I \subset I']$)

The formal analysis of the semantics of *even*. Thus, as shown in (22), the assertion of an *even*-sentence is its prejacent part.

$$(22) \quad \text{The assertion of } \llbracket \text{even} \rrbracket^w(p): p(w)$$

The main semantic contribution of *even* consists in its presupposition, which includes two parts: (i) the prejacent of *even* resolves a degree QUD, and (ii) compared to its alternatives, the prejacent is maximally informative in resolving the QUD.

The presupposition of *even*

As shown in (23), with regard to the contextually salient degree QUD, *how G_{qud} is x_{qud}* , the first part of the presupposition (i.e., on the left side of \wedge) says that ‘in any p -world w' (accessible from the reference world w), the maximally informative answer to the degree question $\lambda I. G_{qud}(x_{qud})(w') \subseteq I$ is a proper subset of the interval $[d_{std}, +\infty)$ ’. In other words, in any world w' , the measurement of x_{qud} along the scale G_{qud} not just reaches but exceeds the contextual standard degree d_{std} , resolving the degree QUD with an increasingly positive answer.

As shown in (24), C , the alternative set of the prejacent p , is a subset of the set of propositions yielded by replacing the focused part of the prejacent with the alternatives to the focus. Based on this, the second part of the presupposition (i.e., on the right side of \wedge) says that ‘for any proposition q in the alternative set of the prejacent p , the maximally informative answer to the question *how G_{qud} is x_{qud} in the p -worlds* is a subset of (i.e., at least as informative as) the maximally informative answer to the question *how G_{qud} is x_{qud} in the q -worlds*’. I call these two maximally informative answers I_p and I_q , and visually represent them in a diagram in (25).

$$(23) \quad \text{The presupposition of } [[\text{even}]]^w(p):$$

$$\forall w' \in \text{Acc}(w) \cap p \left[\underbrace{\text{Max}_{\text{info}}[\lambda I. G_{qud}(x_{qud})(w') \subseteq I]}_{\substack{\text{the most informative interval } I \text{ such that} \\ \text{the measurement of } x_{qud} \text{ along the scale } G_{qud} \\ \text{in } w' \text{ falls within this interval } I \\ \text{i.e., the most informative answer to the question} \\ \text{how } G_{qud} \text{ is } x_{qud} \text{ in } w'}} \right] \subseteq [d_{std}, +\infty) \wedge$$

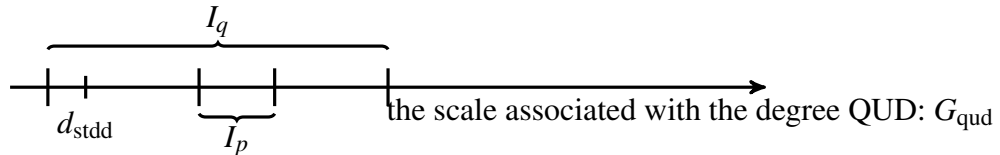
$$\forall q \in C \left[\underbrace{\text{Max}_{\text{info}}[\lambda I. [\forall w' \in \text{Acc}(w) \cap p [G_{qud}(x_{qud})(w') \subseteq I]]]}_{\substack{I_p = \text{the most informative interval that answers the question} \\ \text{how } G_{qud} \text{ is } x_{qud} \text{ in the } p\text{-worlds}}} \right] \subseteq$$

$$\underbrace{\text{Max}_{\text{info}}[\lambda I. [\forall w'' \in \text{Acc}(w) \cap q [G_{qud}(x_{qud})(w'') \subseteq I]]]}_{\substack{I_q = \text{the most informative interval that answers the question} \\ \text{how } G_{qud} \text{ is } x_{qud} \text{ in the } q\text{-worlds}}}$$

$$(24) \quad C \subseteq \{q \mid \exists x. [x \in \text{Alt}([[focus]]) \wedge q = [[Background]](x)]\}$$

(Here $\text{Alt}([[focus]])$ is the set of alternatives to the focused part, and $[[Background]](x)$ yields alternatives to the prejacent p by applying the non-focused part of the prejacent to focus alternatives.)

(25) The degree-QUD-based presupposition of *even* in the current analysis:



$$I_p = \text{Max}_{\text{info}}[\lambda I. [\forall w' \in \text{Acc}(w) \cap p [G_{qud}(x_{qud})(w') \subseteq I]]],$$

$$I_q = \text{Max}_{\text{info}}[\lambda I. [\forall w'' \in \text{Acc}(w) \cap q [G_{qud}(x_{qud})(w'') \subseteq I]]].$$

As shown in (25), I_p is a proper subset of $[d_{\text{std}}, +\infty)$, which is what the first part of the presupposition says (i.e., the lower bound of I_p reaches and exceeds d_{std}), and I_p is a subset of I_q , which is what the second part of the presupposition says (i.e., I_p is maximally informative, as informative as any I_q).

(25) also shows that I_q actually does not provide much information on the degree QUD *how G_{qud} is x_{qud}* , because the lower bound of I_q might or might not be lower than d_{std} . In other words, given the truth of q , it is not even guaranteed that the measurement of x_{qud} reaches the contextual standard d_{std} along the scale of G_{qud} .

In (26), I again use the scenario of Pooh and friends' coming upon a bush of thistles to illustrate the interpretation of an *even*-sentence under the current proposal.

The QUD here is *how prickly those thistles are* (see (26a) and the discussion in Section 2). The assertion of *Even [Eeyore]_F spit the thistles out* is that the prejacent of *even*, i.e., the proposition 'Eeyore spit the thistles out', holds true in the reference world (see (26c)).

The presupposition of *Even [Eeyore]_F spit the thistles out* is that (i) in every world w' where Eeyore spit out the thistles, the thistles are prickly (i.e., more prickly than the contextual threshold), and (ii) in the worlds where 'Eeyore spit out the thistles' holds true, the thistles are I_p -prickly, while in the worlds where 'another one among Pooh and friends spit out the thistles' holds true, the thistles are I_q -prickly, and I_p is as informative as any I_q can be (i.e., I_p is maximally informative).

(26) **Scenario:** Imagine Pooh and friends coming upon a bush of thistles. Eeyore (known to favor thistles) takes a bite but spits out.

Even [Eeyore]_F spit the thistles out.

a. QUD: How prickly are those thistles?

b. $[[\text{prickly}]]^w \stackrel{\text{def}}{=} \lambda I_{\langle dt \rangle} . \lambda x_e . G_{\text{Prickliness}\langle e, \langle s, dt \rangle \rangle}(x)(w) \subseteq I$
(i.e., the measurement of x along the scale $G_{\text{Prickliness}}$ in w falls within the interval I .)

c. The assertion of $[[\text{Even [Eeyore]_F spit the thistles out}]]^w$:
 $\text{spit-the-thistles-out}(\text{Eeyore})(w)$

d. The presupposition of $[[\text{Even [Eeyore]_F spit the thistles out}]]^w$:

$$\forall w' \in \text{Acc}(w) \cap p \left[\underbrace{\text{Max}_{\text{info}}[\lambda I . G_{\text{Prickliness}}(\text{the-thistles})(w') \subseteq I]}_{\text{i.e., the most informative answer to the question}} \right] \subseteq [d_{\text{std}}, +\infty) \wedge$$

i.e., the most informative answer to the question
how prickly are the thistles in w'

$$\forall q \in C \left[\underbrace{\text{Max}_{\text{info}}[\lambda I . [\forall w' \in \text{Acc}(w) \cap p [G_{\text{Prickliness}}(\text{the-thistles})(w') \subseteq I]]]}_{I_p = \text{the most informative interval that answers the question}} \right] \subseteq$$

$I_p = \text{the most informative interval that answers the question}$
how prickly are the thistles in the p -worlds

$$\underbrace{\text{Max}_{\text{info}}[\lambda I . [\forall w'' \in \text{Acc}(w) \cap q [G_{\text{Prickliness}}(\text{the-thistles})(w'') \subseteq I]]]}_{I_q = \text{the most informative interval that answers the question}}$$

$I_q = \text{the most informative interval that answers the question}$
how prickly are the thistles in the q -worlds

The analysis in (26) is clearly consistent with our intuition for the interpretation of *Even* [*Eeyore*]_F *spit the thistles out* under the given scenario. From the truth of the proposition ‘Eeyore spit the thistles out’, we know that the thistles must be really prickly. On the other hand, from the truth of alternative propositions like ‘Pooh spit the thistles out’, it remains rather unknown whether the thistles are prickly or not.

Below I show that under the current analysis, inferences of entity-based additivity and likelihood-based scalarity, which are considered presuppositions under the canonical view, are now considered implicatures (Sections 3.1 and 3.2).

3.1 Entity-based additivity is not necessary

As already shown in Section 1, to felicitously use *even*, entity-based additivity is not necessarily satisfied. In the example of Pooh and friends’ coming upon a bush of thistles, Eeyore was the only one who took a bite of thistles and spit them out, yet it is felicitous to utter *Even* [*Eeyore*]_F *spit the thistles out* to make the point that the thistles are really prickly (see (2) and more discussion in Section 2).

Entity-based additivity means that within the alternative set of the prejacent of an *even*-sentence, there exists an alternative q which is different from the prejacent p , and this alternative proposition q holds true in the reference world w (see (27)).

$$(27) \quad \text{Entity-based additivity for } \llbracket \text{even} \rrbracket^w(p): \exists q \in C[q \neq p \wedge q(w)]$$

Under the current analysis (see (22) and (23)), nothing guarantees (27). The alternatives of the prejacent only appear in the second part of the presupposition (see (23)). What matters is, compared to the prejacent, how these alternatives inform on the resolution of the contextually salient degree QUD. Whether alternatives hold true in the reference world is irrelevant in the interpretation of an *even*-sentence. Thus, the current analysis correctly predicts that entity-based additivity is not necessary in the use of *even*. In other words, even if entity-based additivity is involved in our intuitive interpretation of an *even*-sentence, this kind of inference can at most be an implicature, which is cancellable (see more discussion in Section 3.2).

Here is one more example. Under the scenario in (28), Bill is the only kid who has jumped. By uttering this *even*-sentence, the teacher means that the ditch is really easy to jump over, suggesting that other kids will also jump over it. But they might not. Yet this *even*-sentence is felicitous even if eventually no one else succeeds.

- (28) **Scenario:** A group of kids are lining up to jump over a ditch. Bill, known to be a physically weak kid, is the first and successfully jumps over the ditch. Their teacher wants to encourage the other kids who haven’t jumped yet:
- a. ‘Even [*Bill*]_F jumped over the ditch.’

3.2 Likelihood-based scalarity (and entity-based additivity) as an implicature

Also, as already shown in Section 1, ample empirical evidence suggests that a low likelihood of the prejacent is neither a necessary nor a sufficient condition for felicitous uses of *even*. Indeed, proposition-level likelihood-based scalarity (see (29)) is not part of the current analysis of *even* (see (22) and (23)).

(29) Likelihood-based scalarity for $\llbracket \text{even} \rrbracket^w(p)$: $\forall q \in C[q \neq p \rightarrow p >_{\text{Unlikely}} q]$

Under the current analysis, the comparison between the prejacent of *even* and alternatives (see the second part of the presupposition in (23)) is based on their informativeness in resolving a contextually salient degree QUD.

With regard to the example (3) (repeated here in (30)), as pointed out by Rullmann (1997), the likelihood of the prejacent (i.e., *He read Manufacturing Consent*) is irrelevant. Under the current analysis, the felicity of the use of *even* is based on (i) how this prejacent resolves the contextually salient degree QUD, *how non-conformist is John*, and (ii) how, in addressing the QUD, this prejacent is more informative, compared to alternative propositions (e.g., *He read Syntactic Structures*).

(30) John is a political non-conformist. He even read $[\textit{Manufacturing Consent}]_F$ although it has been banned by the censorship committee. (= (3))

Similarly, with regard to the example (4) (repeated in (31)), likelihood is also irrelevant in interpreting *the one on the left is even made of [steel]_F*. The felicity of the use of *even* is based on (i) how the prejacent resolves the degree QUD, *how strong are both tools* (see also later discussion on (39) for this kind of QUDs), and (ii) how, in addressing this QUD, the prejacent is more informative, compared to alternative propositions (e.g., *the one on the left is made of strong aluminum*).

(31) Seller to client: Both tools are strong. The one on the right is made of strong aluminum, and the one of the left is even made of $[\textit{steel}]_F$. (= (4))

However, with regard to the example (5) (repeated in (32)), since there is no salient degree question that serves as the QUD here, the use of *even* becomes weird.

(32) The red box has fruits. The blue one (#even) has $[\textit{apples}]_F$ in it. (= (5))

Rullmann (1997) raises two issues on the scalarity of *even* (see Section 4 of his paper): (i) what kind of scale is involved; (ii) whether the interpretation of *even* is related to a superlative meaning (i.e., an endpoint, e.g., the least likelihood).³ For the first issue, under the current analysis, the scale of likelihood is never involved.

³ Rullmann (1997) actually raises three issues. The third issue is about entity-based additivity.

There are two kinds of scales involved in the current analysis of *even*: (i) the scale associated with the contextually salient degree QUD (e.g., a scale of exhibitions' success, associated with *how successful a certain exhibition is* in interpreting *even [Mary]_F came*, or a scale of thistles' prickliness, associated with *how prickly the thistles are* in interpreting *even [Eeyore]_F spit those thistles out*); (ii) the scale of informativeness in comparing the prejacent of *even* and its alternatives.

Along both scales, I use the entailment between intervals to characterize the relation between items under comparison: as shown in (25), (i) the comparison between I_p and $[d_{\text{std}}, +\infty)$ along the scale associated with the degree QUD, and (ii) the comparison between I_p and I_q along the scale of informativeness.

For the second issue raised by Rullmann (1997), under the current analysis, the comparison along the scale of informativeness is related to a superlative meaning.

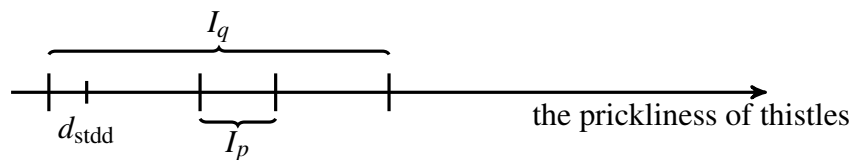
In (33) (Rullmann 1997: 45, (19b)), with *even*, this sentence not just provides information on *how many children they have*, but crucially, resolves an implicit degree QUD: e.g., *how enthusiastic / nervous they are towards having children*.

(33) Ed has two children and Fred even has $[\text{three}]_F$. (Rullmann 1997: (19b))

Thus, *Fred even has $[\text{three}]_F$ children* presupposes that (i) the truth of *Fred has 3 children* indicates that their enthusiasm (or nervousness) is above the contextual threshold, and (ii) *Fred has 3 children* is as informative as any of its alternatives in resolving the degree QUD. The second part of the presupposition means that even if the focused item here, 3, is not the largest number among its alternatives, sentences like *Fred has 4 children* are not considered more informative than *Fred has 3 children* in telling about people's enthusiasm (or nervousness). I.e., the prejacent of *even* is considered maximally informative in resolving the degree QUD.

This superlative meaning along the scale of informativeness also explains why there are low likelihood inferences in interpreting *even*-sentences. Let's come back to the example of Pooh and friends' coming upon a bush of thistles. As illustrated in (34), $I_p \subseteq I_q$. Thus the likelihood of 'the thistles are I_p -prickly' cannot be higher than the likelihood of 'the thistles are I_q -prickly'. I.e., the prejacent is associated with the least likelihood on the information of how prickly the thistles are.

(34) Even $[\text{Eeyore}]_F$ spit the thistles out.



I_p = how prickly the thistles are, if Eeyore spit them out.

I_q = how prickly the thistles are, if Pooh spit them out.

Similarly, for the example on John’s reading materials (see (3)/(30)), the use of *even* indicates that John’s being a non-conformist reaches a rare extent. For the scenario with regard to the selling of tools (see (4)/(31)), the use of *even* indicates that the strength of the tools is high, and unexpectedly high.

To sum up, low likelihood inferences are not at the (prejacent) proposition level, but at the level of the resolution of the degree QUD.

According to Rullmann (1997), inferences of entity-based additivity (dubbed as existential presupposition in his paper) are further built on low likelihood inferences, in an indirect way. His reasoning can be carried over to the current proposal.

As illustrated in (34), since $I_p \subseteq I_q$, if Eeyore spit the thistles out in a world w' where the thistles are I_p -prickly, then w' is also a world where the thistles are I_q -prickly, and we are inclined to believe that q should hold true in w' , e.g., Pooh also spit the thistles out in this world w' . Hence the inference of entity-based additivity.⁴

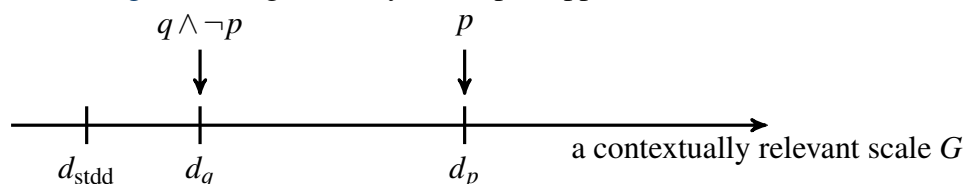
Of course, this inclination only leads to an implicature. There can still be a p -world where q does not hold true, e.g., the reference world of the example on Pooh and Eeyore’s coming upon thistles. After all, both this inclination and low likelihood inferences are based on ' $I_p \subseteq I_q$ ', not ' $p \subseteq q$ ' (i.e., all the p -worlds are q -worlds).

4 Discussion: comparison with Greenberg (2018)

Greenberg (2018) also challenges the classical likelihood-based analysis of *even* and proposes a gradability-based account (see also Greenberg 2015, 2016).

As shown in (35), the use of *even* presupposes that along a contextually relevant scale G where we take the measurement of a certain item, x (both x and G are from context), the largest degree such that the measurement of x reaches in all the worlds where the prejacent p holds true is d_p , and the largest degree such that the measurement of x reaches in all the worlds where $q \wedge \neg p$ (q is an alternative to the prejacent) holds true is d_q , and these two degree values d_p and d_q are such that (i) d_p exceeds d_q , and (ii) d_q reaches the contextual standard value d_{std} .

(35) Greenberg (2018)’s gradability-based presupposition of *even*:



Presupposition:

$$\forall q[q \in C \wedge q \neq p \rightarrow \forall w_1, w_2 \in \text{Acc}(w)[p(w_2) \wedge [q \wedge \neq p](w_1) \rightarrow$$

⁴ See Szabolcsi (2017) for a different approach to derive entity-based additive inferences for lexical items like *even* and *also*.

The presupposition of *even*

$$\begin{aligned} & \text{Max}[\lambda d_p \cdot G(d_p)(x)(w_2)] > \text{Max}[\lambda d_q \cdot G(d_q)(x)(w_1)] \wedge \\ & \text{Max}[\lambda d_q \cdot G(d_q)(x)(w_1)] \geq d_{\text{std}} \end{aligned}$$

The current proposal and Greenberg (2018) are similar in that both accounts reject the direct use of likelihood scales in comparing the prejacent of *even* and its alternatives. Instead, Greenberg (2018) adopts a contextually relevant scale G to measure x . The current proposal is in the same spirit, adopting a scale that aims to resolve a degree QUD. With regard to the example on Pooh and friends' coming upon a bush of thistles, for both accounts, G is considered a prickliness scale for thistles, and a sentence like *Even [Eeyore]_F spit the thistles out* essentially addresses the prickliness measurement of those thistles Pooh and Eeyore encounter.

Another similarity shared by Greenberg (2018) and the current analysis is that the evaluative meaning is considered part of the presupposition of *even*. Thus for *Even [Eeyore]_F spit the thistles out*, the prejacent indicates a high degree of prickliness, above the contextual threshold.

Then the current proposal and Greenberg (2018) are different in a few aspects:

One scale vs. two scales. First, and most fundamentally, only one scale is involved in the analysis of Greenberg (2018), while, as addressed in Section 3.2, two kinds of scales are involved in the current analysis.

According to Greenberg (2018)'s analysis, in interpreting *Even [Eeyore]_F spit the thistles out*, both (i) the evaluative meaning (which indicates a high degree of prickliness of the thistles) and (ii) the comparison between the prejacent and its alternatives are based on the scale of prickliness for thistles.

However, under the current analysis, only the evaluative meaning is based on this scale of prickliness for thistles. The comparison between the prejacent and its alternatives is based on a scale of informativeness.

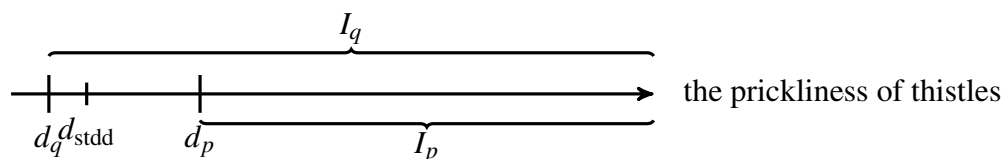
This fundamental difference leads to the next four differences.

Degrees va. intervals. For formal implementation, to (i) derive the evaluative meaning and (ii) conduct a comparison between the prejacent and its alternatives, Greenberg (2018) adopts the inequality relation between degrees (along the same scale, e.g., the scale of prickliness of thistles).

The current account adopts intervals, a more generalized notion, to represent scalar values, and use the entailment relation between intervals to conduct comparison. The evaluative meaning is derived when an interval I is a proper subset of $[d_{\text{std}}, +\infty)$, i.e., the lower bound of I exceeds the contextual standard d_{std} . Then the comparison between intervals along the scale of informativeness directly follows the entailment relation between sets, because intervals are convex sets of degrees.

Apparently, it seems that these two different formal implementations are somehow convertible between one another. For the example on thistles, we can naturally assume that when thistles get very prickly, anyone would spit them out. Thus, as shown in (36), both I_p and I_q can be considered right-unbounded, and mathematically, the entailment relation between two intervals (here among I_p , I_q , and $[d_{\text{std}}, +\infty)$) amounts to the inequality relation between their lower bounds.

(36) Even $[\text{Eeyore}]_F$ spit the thistles out.



$I_p = [d_p, +\infty)$ = how prickly the thistles are, if Eeyore spit them out.

$I_q = [d_q, +\infty)$ = how prickly the thistles are, if Pooh spit them out.

However, in terms of natural language interpretation, the entailment relation between I_p and I_q actually conveys more information than the inequality relation between d_p and d_q . The entailment relation between $[d_p, +\infty) \subseteq [d_q, +\infty)$ says not only that $d_p \geq d_q$, but also makes sentences containing $[d_p, +\infty)$ more informative than those containing $[d_q, +\infty)$. The inequality relation $d_p \geq d_q$ does not lead to a comparison of informativeness (see (37): $3 > 2$, but (37a) does not entail (37b)).

- (37) a. I read exactly 3 novels. \rightsquigarrow the cardinality of all the novels I read = 3
 b. I read exactly 2 novels. \rightsquigarrow the cardinality of all the novels I read = 2

Therefore, with the use of interval technique, the current analysis supports the comparison of informativeness between the prejacent and its alternatives.

Comparing the prejacent with its alternatives. Following the technical choice addressed above, in the analysis of Greenberg (2018), the comparison between the prejacent p and an alternative q amounts to an inequality relation between d_p and d_q . However, under the current analysis, the comparison between the prejacent p and an alternative q amounts to a comparison of informativeness between I_p and I_q .

There are at least two reasons to think that the comparison of informativeness on how I_p and I_q resolve a degree QUD is better motivated than the comparison between d_p and d_q .

First, according to Gricean pragmatics, interlocutors should make their utterance as informative as possible. Thus, if the utterance of p contributes the maximal information to resolve the contextually salient QUD, then p should be uttered, not its alternatives. In this sense, it is reasonable and natural to compare the uttered

prejacent with its non-uttered alternatives in terms of informativeness.

Second, it seems stipulative to require that d_p be larger than d_q . How about we accommodate a reversed scale and require that d_p be lower than d_q ? According to Greenberg (2018), this kind of over-generation can be avoided, due to the second conjunct in the presupposition: $d_q \geq d_{\text{std}}$ (see (35)), i.e., degrees associated with alternatives reach the contextual threshold. With a reversed scale, the inequality relations would become $d_{\text{std}} \geq d_q > d_p$, failing to meet the requirement ‘ $d_q \geq d_{\text{std}}$ ’. Below I show why this requirement is actually questionable.

Are there evaluative inferences for alternatives? Under the current proposal, only the prejacent brings an evaluative meaning, i.e., $I_p \subset [d_{\text{std}}, +\infty)$ (see (23)/(25)), resolving the degree QUD with an increasingly positive answer. This kind of evaluative meaning is irrelevant to alternatives (i.e., ‘ $I_q \subseteq [d_{\text{std}}, +\infty)$ ’ is not required). However, according to Greenberg (2018), ‘ $d_q \geq d_{\text{std}}$ ’ is required.

In (38), the use of the *even*-sentence is felicitous under its context. Obviously, in this example, in the worlds where Pooh spit out thistles but Eeyore did not, the prickliness degree of the thistles does not necessarily reach the contextual threshold of prickliness. This counter-example suggests that ‘ $d_q \geq d_{\text{std}}$ ’ or ‘ $I_q \subseteq [d_{\text{std}}, +\infty)$ ’ is not required. In other words, alternatives do not necessarily provide information to resolve the degree QUD with a positive answer.

- (38) **Scenario:** Imagine Pooh and friends coming upon a bush of thistles. Only Eeyore is known to favor thistles, and Eeyore does not eat thistles that are too prickly, while **Pooh and other friends don’t eat any thistles, no matter they are prickly or smooth**. Eeyore takes a bite but spits it out.
- a. Those thistles must be really prickly! Even [Eeyore]_F spit them out!

Greenberg (2018)’s proposal of ‘ $d_q \geq d_{\text{std}}$ ’ is motivated by examples like (39). Intuitively, *even* can only be felicitously used in (39a), but not in (39b) or (39c). According to Greenberg (2018), the infelicity of using *even* in (39b) or (39c) is due to their failure of satisfying ‘ $d_q \geq d_{\text{std}}$ ’. In (39b) and (39c), the height of John does not reach the contextual standard, here *1.90 m*.

- (39) **Context:** John and Bill want to join our basketball team, where the standard for player height is 1.90 m. (Greenberg 2018: 58, (17))
Coach: So – what about John and Bill?
- a. John is 1.95 m tall and Bill is (even) [2.10]_F tall.
b. John is 1.70 m tall and Bill is (#even) [1.75]_F tall.
c. John is 1.75 m tall and Bill is (#even) [1.95]_F tall.

The current proposal can provide an alternative account. Under this context, the

most salient degree QUD is about the eligibility of both John and Bill. Thus the use of *even* is to indicate an increasingly positive answer to this degree QUD. I.e., the prejacent *Bill is 1.95 tall* is to provide information that both people are tall.

Explaining low likelihood inferences. Under the current analysis, low likelihood inferences are based on ' $I_p \subseteq I_q$ ' (see Section 3.2). Given that I_p entails I_q , the likelihood of 'the thistles are I_p -prickly' cannot be higher than the likelihood of 'the thistles are I_q -prickly'. I.e., the prejacent is associated with the maximal informativeness to address the QUD, and thus the least likelihood.

According to Greenberg (2018) (see her Footnote 29), since the use of *even* presupposes ' $d_p > d_q \geq d_{\text{std}}$ ', if we assume a normal distribution along the relevant scale, then the degree associated with the prejacent, d_p , should lead to a lower likelihood than the contextual standard, d_{std} .

The explanation provided by the current proposal might have two advantages. First, it does not require the additional assumption of a normal distribution. Second, we intuitively feel that it is compared to its alternatives, not d_{std} , that the prejacent of *even* is associated with a lower likelihood, or some kind of surprise. Thus for Greenberg (2018), low likelihood inferences need to be based on the part ' $d_p > d_q$ ', not ' $d_p > d_{\text{std}}$ '. However, as I have addressed earlier, whether ' $d_q \geq d_{\text{std}}$ ' holds true in interpreting an *even*-sentence seems debatable, and if d_p and d_q are on different sides of d_{std} (i.e., $d_p > d_{\text{std}} > d_q$), the assumption of a normal distribution does not help to address whether d_p leads to a lower likelihood than d_q .

5 Outlook and concluding remarks

In this paper, based on a novel observation that there is no apparent focus/QUD congruence for *even*-sentences, I propose a new degree-QUD-based analysis for the presupposition of *even*. The use of *even* is always based on a contextually salient degree QUD: the prejacent of *even* provides information to resolve this degree QUD with an increasingly positive answer, and compared with alternatives, this prejacent is also considered maximally informative in resolving this degree QUD.

The proposed new analysis for the presupposition of *even* also raises new questions for more *even*-related research. One issue is about how the current proposal brings new insights to (i) the interplay between *even* and downward-entailing and non-monotonic operators, (ii) how *even* is used in questions, and (iii) the potential existence of a covert *even*-like item in negative polarity items (see e.g., Lahiri 1998; Guerzoni 2003, 2004; Crnić 2013; Chierchia 2013).

Another issue is about how the current analysis of *even* can be extended to provide a compositional account for expressions like *even if* and *even though*.

Furthermore, the current account for the presupposition of *even* should also shed

light on the semantics of cross-linguistic siblings of English *even*: e.g., *-mol-demo* in Japanese (see Nakanishi 2006); (*lián ...*) *dōu* in Mandarin Chinese (see Liu 2017). It is worth investigating how all these focus-sensitive particles are similar and different in contributing to discourse coherence.

More broadly, the current degree-QUD-based analysis of *even* also involves a new perspective on the maximality of informativeness. The maximality of informativeness is usually considered based on entailment (see Schlenker 2012; Von Stechow, Fox & Iatridou 2014), while in this paper, the maximality of informativeness is based on how a degree QUD is resolved, i.e., the measurement along a certain contextually relevant scale. A further investigation on this new perspective on the maximality of informativeness is also left for another occasion (see Zhang 2022 for a short discussion).

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