

Restrictions on the position of *exh**

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Abstract The grammatical approach to scalar implicatures attributes their introduction to a covert operator *exh*, which can be posited in various structural positions. By studying the interaction of scalar implicature calculation and the presuppositions of English *also* and *again*, we are able to pinpoint the structural position of *exh*. This diagnostic shows that some triggers of scalar implicature require *exh* to be adjoined as low as possible above them, whereas other triggers allow for more delayed adjunction of *exh*. We offer a concrete proposal for these behaviors in terms of syntactic feature-checking and show how it extends to cases involving ignorance inferences.

Keywords: scalar implicature, *exh*, focus particles, presupposition, *also*, *again*, ignorance implicatures, presupposed ignorance, English

1 Introduction

The meanings contributed by logical expressions are frequently “strengthened” through the addition of a *scalar implicature* (SI). For example, in many contexts, the disjunction in (1) will be interpreted as an exclusive disjunction, as if with an implicit “but not both.” The SI trigger *or* contrasts with *and*; as a variant of (1) with *and* is logically stronger, the negation of this stronger alternative is expressed as its SI, informally given in (1) after \rightsquigarrow .

(1) Nina teaches Arabic or Basque. \rightsquigarrow Nina does not teach Arabic and Basque.

The grammatical approach to SI attributes such inferences to the presence of a covert operator *exh* with exhaustive particle semantics similar to *only* (Fox 2007; Chierchia, Fox & Spector 2012, a.o.).¹ *Exh* is assumed to be a sentential focus particle that adjoins to a node of propositional type, like sentential *only*.² Assuming

* We thank Brian Buccola, Yasutada Sudo, and Jianrong Yu for discussion of this work.

1 Here we do not review the more traditional, pragmatic approach to SI calculation, strongly associated with the tradition of Grice 1989 et seq. See e.g. Chierchia et al. 2012 for a critical introduction.

2 “Sentential” focus particles contrast with so-called “constituent” focus particles. The latter take a non-propositional sister (such as a noun phrase) to form a quantificational argument meaning, or else indicate the presence of a corresponding covert operator. For further discussion of these two types of focus particles, see e.g. Erlewine 2017 and Branau & Erlewine 2022.

that the surface subject *Nina* originates in a lower, predicate-internal position and then moves higher (the *predicate-internal subject hypothesis*; see e.g. McCloskey 1997, Heim & Kratzer 1998: §8.4), there are at least two different positions where *exh* could adjoin in (1), illustrated in (2): taking the entire TP in its scope (position ①), or just above the predicate (vP), below T and the surface subject (position ②).

(2) **Multiple possible positions for *exh* in (1):**

(① *exh*) [TP Nina T_{PRES} (② *exh*) [vP ___ teaches [Arabic or Basque]]]

In this case, positing *exh* in either of these positions will result in the same, correct SI for (1). Is the choice of position for *exh* then free? Are there any constraints on its placement? Complicating matters, of course, is the fact that *exh* is unpronounced, so surface representations are uninformative.

In this paper, we argue that the grammar *does* impose structural restrictions on the placement of *exh*. In particular, certain SI triggers in English, including disjunction as well as unstressed *some* and bare numerals, require an associated *exh* to be as low as possible above the trigger; for instance, in position ② but not position ① in (2) above. However, this requirement is lexicalized, as certain other SI triggers allow for more delayed exhaustification. Our evidence throughout comes from the interaction of SI with additive particles (*also*, *too*) and *again*, building on Spector & Sudo 2017 and Marty & Romoli 2021.

Our paper proceeds as follows. In section 2, we introduce the use of additive particles and *again* to pinpoint the position of *exh*, and show that some SI triggers require *exh* as low as possible. In section 3, we discuss variation among SI triggers in English and offer a syntactic proposal that accounts for these behaviors. In section 4, we extend our analysis to cases involving ignorance inferences discussed by Marty & Romoli (2021). Using additive particles, we show that it must be possible to generate ignorance inferences in embedded positions, contrary to the tenets of Meyer’s (2013) “Matrix K” theory which takes ignorance inferences to be generated by *exh* above a doxastic modal operator adjoined to assertive clauses.

2 Using presupposition triggers to identify the position of *exh*

We propose that the use of presupposition triggers such as *also* and *again* can be used as a diagnostic for the position of *exh*. Spector & Sudo (2017) (S&S) discuss contrasts such as in (3) below, adapted from their examples.³ We see in (3) that the additive presupposition of *also* with a disjunctive predicate is satisfied by a matching disjunctive antecedent (3a), but not by a corresponding conjunctive antecedent (3b).

³ S&S report the pattern of behavior in (3) but with postnominal *too* in their examples (see their pages 510–511), which forms a constituent with its sister noun phrase. In other words, compared to our *Nina*

- (3) **Additive with disjunctive preajcent requires a disjunctive antecedent:**
- a. Mira teaches Arabic or Basque. *disjunctive antecedent*
 ✓ [Nina]_F **also** teaches Arabic or Basque.
- b. Mira teaches Arabic and Basque. *conjunctive antecedent*
 # [Nina]_F **also** teaches Arabic or Basque.

S&S note that — setting aside any strengthening by implicature — we expect both of the examples in (3) to be felicitous. Additives such as *also* and *too* require a salient focus alternative to be true (Kripke 1990/2009; Heim 1992). In all three cases in (3), we predict the additive particle to presuppose that another salient individual teaches Arabic or Basque. Since the conjunctive antecedent entails the corresponding disjunctive proposition, we expect the additive presupposition to be satisfied in (3b), contrary to fact.

S&S propose that the contrast in (3) is due to the effect of embedded SI calculation, with *exh* applying within the scope of the additive. See (4) below. Here we use A_x to stand for the proposition ‘that x teaches Arabic’ and B_x for ‘that x teaches Basque.’ *Also* in (4) will presuppose that $exh(A_x \vee B_x)$ is true for some other salient individual x . In other words, (4) requires that a contextually salient individual teaches Arabic or Basque, but not both. This presupposition is satisfied in (3a) but not (3b) and so this *also* > *exh* parse accurately predicts the contrast in (3a,b).

- (4) **also** [*exh* [$A_{Nina} \vee B_{Nina}$]]
 $\overset{\text{ALSO}}{\rightsquigarrow} exh(A_x \vee B_x) = (A_x \vee B_x) \wedge \neg(A_x \wedge B_x)$ for some salient individual x

However, we might also consider another, alternative parse where *exh* takes scope over *also*, schematized in (5) below. The application of *exh* above *also* results in *also* applying to the disjunctive preajcent as well as *also* (under negation) applying to the conjunctive alternative, as seen in the first line of (5). We therefore predict *also* to presuppose the truth of a salient conjunctive alternative of the form $(A_y \wedge B_y)$ for some individual y .⁴ We then predict this parse in (5) to be felicitous in (3b) where a salient individual, Mira, teaches both Arabic and Basque, but infelicitous with a disjunctive antecedent as in (3a).

also teaches... examples, S&S present examples of the form *Nina, too, teaches...* In our judgment, postnominal *too* generally feels more marked, and so we instead use *also* in all of our examples. *Also* is unambiguously a sentential particle and, as we shall see, has the additional virtue of taking scope in its surface position, which will be valuable for our purposes.

The parallel judgments that S&S report with postnominal *too* can be understood if constituent *too* reflects the presence of a corresponding sentential operator (covert ALSO). See also Branán & Erlewine 2022 for a more general theory of constituent particles as markers that indicate the presence of a covert sentential operator.

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$$(5) \quad \underset{\sim \rightsquigarrow \text{ALSO}}{\text{exh}} [\text{also} [A_{\text{Nina}} \vee B_{\text{Nina}}]] = \text{also} [A_{\text{Nina}} \vee B_{\text{Nina}}] \wedge \neg \text{also} [A_{\text{Nina}} \wedge B_{\text{Nina}}] \\ (A_x \vee B_x) \wedge (A_y \wedge B_y) \text{ for some salient individuals } x, y$$

S&S conclude (pp. 511–512) that the facts as in (3a,b) show that *exh* must scope below *also* (4), not above (5), but do not offer an explanation for this restriction.

Let us consider what S&S’s discussion teaches us about the syntactic placement of *exh*, in greater detail. Following Rullmann 2003 and Erlewine 2014, we assume that *also* is interpreted in its surface position, adjoined to *vP*. (This choice departs from S&S’s assumptions, as we discuss in section 2.1 below.) We illustrate the syntactic structure of the second sentence of (3a,b) in (6) below. Assuming the predicate-internal subject hypothesis, *also* in (3a,b) associates with the focus-marked subject *Nina* which moves out of its scope (6). Erlewine (2014) proposes that *also* in such configurations associates with the lower copy of the subject, not illustrated here. As noted in the introduction, there are at least two positions in (6) where we might imagine *exh* adjoining, including taking TP as its sister (position ①) and taking *vP* as its sister (position ②). S&S’s result teaches us that *exh* may adjoin to *vP* (position ②) but not to TP (position ①).⁵

$$(6) \quad (\textcircled{1} \text{ *exh}) [_{\text{TP}} [\text{Nina}]_{\text{F}} \text{ T}_{\text{PRES}} [\text{also} [(\textcircled{2} \checkmark \text{exh}) [_{\text{vP}} \text{ ___ } \text{ teaches } [A. \text{ or } B.]]]]]]$$

Having restated S&S’s conclusion in syntactic terms, what might explain this restriction? One hypothesis would be to propose that *exh* is generally unable to adjoin to TP and must adjoin to *vP*. However, evidence against this strict prohibition comes from examples such as (7) below. This example is modeled after the infelicitous example (3b) above but with both sentences passivized, so that the disjunction is in subject position, above *also*. In contrast to (3b) above, (7) is judged as felicitous. In this case, *exh* must adjoin to TP in order to take its trigger in its scope. With *also* taking scope below *exh* as in (4), we correctly predict it to be felicitous with a conjunctive antecedent.

(7) **Disjunction in subject allows for conjunctive antecedent for *also*:**

Arabic and Basque are taught by Mira.

✓ Arabic or Basque is **also** taught by [Nina]_F.

4 In particular, the negation \neg in (5) introduced by the calculation of *exh* is a presupposition hole. This follows the conception of *exh* that S&S argue for in detail; see their definition of EXH² on p. 498 as well as their discussion of this parse on p. 511.

Also in (5) also presupposes the truth of a salient alternative of the form $(A_x \vee B_x)$, but there is no requirement that the individuals x and y in the salient alternatives differ.

5 Adjoining *exh* to the projection of *vP* that includes the adjoined *also* will, for our purposes here, be indistinguishable from adjunction to TP and therefore must also be ruled out.

In summary, we can use such patterns of the (in)felicity of additive *also* with a logically stronger antecedent to determine the precise position of *exh*. We summarize the attested positions for *exh* as follows:

(8) a. [TP [Nina]_F T_{PRES} [*also* [*exh* [_{VP} ___ teaches [A. or B.]]]]] (3)

b. *exh* [TP [A. or B.] is [*also* [_{VP} taught ___ by [Nina]_F]]] (7)

In particular, the possibility of *exh* adjoining to TP in (7/8b) forms an argument against a blanket ban against *exh* adjoining to TP, and therefore necessitates a separate explanation for the unavailability of *exh* adjoining to TP in (3/8a).

We propose instead that the distribution of *exh* with disjunction is subject to the generalization in (9):

(9) ***Exh* as low as possible:**

(For some SI triggers,) *exh* must adjoin to the lowest position where it is not vacuous.

We note that overt sentential focus particles in various languages are also subject to a requirement that they adjoin as low as possible, as in Awing (Grassfields Bantu; Fominyam & Šimík 2017), English (Francis 2019: 57), German (Jacobs 1983; Buring & Hartmann 2001),⁶ Mandarin Chinese (Erlewine 2015a, 2022), and Vietnamese (Erlewine 2015b, 2017). Our work here thus suggests that covert *exh* shares *syntactic* characteristics with that of overt focus particles in some languages, as may be unsurprising on the view of *exh* as a focus particle in the grammar. It also strengthens the case against the Neo-Gricean approach to SIs, which predicts implicatures to be generated globally.

In the remainder of this section, we will further motivate this generalization and show that it also holds of *exh* as applied to bare numerals and unstressed *some*, as well as conjunction and *all* under scale-reversal. We will also present supporting evidence for these conclusions from the presupposition of *again*. Then in section 3, we show that not all SI triggers require *exh* to adjoin as low as possible, and put forward a proposal using syntactic feature-checking that will account for this generalization and its lexical variation.

2.1 On the scope and position of *also*

An important component of our discussion above is that we take *also* to take scope in its surface position, following Rullmann 2003 and Erlewine 2014. This allows us to derive the contrast in behaviors for SI triggers inside versus outside the surface

⁶ The German description is however controversial. See e.g. Reis 2005 and Smeets & Wagner 2018.

scope of the additive, as in (3) vs (7) above. In contrast, the presentation in S&S assumes that additives (in their examples, *too*) always take scope over the entire clause, which offers no path for explaining such contrasts.

The contrast between (3) and (7) above is not simply due to the relative linear or structural position of the SI trigger (disjunction) and the focus of *also* (there, *Nina*). When both the SI trigger and the focus associate are within *vP*, *exh* must adjoin to *vP*, below *also*, leading to infelicity in both (10a) and (10b). What matters is the lowest position that *exh* may apply non-vacuously, following (9), with respect to the scope of the additive.

(10) **No sensitivity to relative position of SI trigger and focus inside *vP*:**

- a. Otto sent apples and bananas to Pia.
Otto **also** sent apples or bananas to [Quinn]_F.
- b. Otto sent Pia apples and bananas.
Otto **also** sent [Quinn]_F apples or bananas.

We also observe a clear sensitivity to the position of *also* in (11). The contrast here is explained by *exh* needing to be adjoined just above the experiencer, which contains the SI trigger. The position of *exh* will then be within the scope of *also* in (11a) but above it in (11b). Again, we assume here that additive *also* associates from its surface position with the lower copy of its focus associate (here, *the murderer*) when it has moved out of the scope of *also* (Erlewine 2014; see also Erlewine 2018).

(11) **Sensitivity to the position of *also* with respect to the SI trigger:**

- The accomplice seems to the judge and the jury to be remorseful...
- a. # [The murderer]_F **also** seems to the judge or the jury to be remorseful.
 - b. ✓ [The murderer]_F seems to the judge or the jury to **also** be remorseful.

We can further test the predictions of this approach by introducing an additive particle at a higher position in the clause. In (12), *too* scopes above the subject by taking a sentence-level adjunct as its focus associate. Here, we correctly predict that the additive presupposition cannot be satisfied by a conjunctive antecedent, regardless of whether the disjunction is in object position (12a) or subject position (12b). In either case, the lowest position where *exh* can and therefore must adjoin will be within the scope of the additive.

(12) **No object vs subject asymmetry with additive above TP:**

- a. Yesterday, Ritva ate chocolate and ice-cream.
[Today]_F **too**, Ritva ate chocolate or ice-cream.
- b. Yesterday, Ritva and Sanna went to the supermarket.
[Today]_F **too**, Ritva or Sanna went to the supermarket.

2.2 Bare numerals and *some*

Next, we show that bare numerals and unstressed *some* are like disjunction, in that they require an associated *exh* to adjoin to the lowest possible position above them.

We assume that bare numerals have an *at least n* interpretation and then are frequently strengthened to an *exactly n* interpretation due to the presence of *exh* (Horn 1972; Spector 2013). The infelicity of (13a), where the bare numeral scopes under *also*, suggests that *exh* obligatorily scopes below *also*, requiring a salient individual to have stolen exactly two books. When the sentences are passivized as in (13b) so that the SI trigger is above the additive, the additive then allows for the corresponding logically stronger antecedent.

(13) Bare numerals require *exh* as low as possible:

- a. Guy stole three books. # [Hlee]_F **also** stole two books.
- b. Three books were stolen by G. ✓ Two books were **also** stolen by [H.]_F.

Some, especially when unstressed (which we write as *sm*), also exhibits the same contrast, as in (14) below. We discuss this judgment further in section 3.2 below.

(14) Unstressed *some* (*sm*) requires *exh* as low as possible:

- a. Evy met all of the students. # [Fran]_F **also** met sm of the students.
- b. All of the students met Evy. ✓ Sm of the students **also** met [Fran]_F.

Bare numerals (13) and unstressed *some* (14) exhibit the behavior of disjunction in (3) vs (7), which we might call the signature contrast of an SI trigger that requires *exh* to adjoin as low as possible: additives allow for a logically stronger antecedent (*three* for *two*, *all* for *sm*) with the trigger above the additive but not below it, as *exh* must adjoin below the additive and strengthens its presupposition in the latter case.

2.3 Indirect scalar implicatures⁷

Whereas direct SIs arise by strengthening a logically weaker term by excluding its stronger alternatives (e.g. *or* \rightsquigarrow *not and*), so-called “indirect SIs” arise when a stronger scalar item (e.g. *and*) is under negation or another scale-reversal environment (Chierchia 2004). For instance, example (15) with its surface scope (*not > and*) reading introduces the SI that the alternative ‘that Mira doesn’t teach Arabic or Basque’ is false.

(15) Indirect SI of *and* under negation:

- Nina doesn’t teach Arabic and Basque. \rightsquigarrow Nina teaches Arabic or Basque.

⁷ We thank Yasutada Sudo for the suggestion to consider indirect SIs.

Strengthening by indirect SIs can also take place within the scope of an additive. Consider (16), again targeting the surface scope (*not > and*) reading for the second sentence. The use of the additive is felicitous with a matching *not > and* antecedent (16a) but infelicitous with the logically stronger *not > or* antecedent in (16b).

(16) **Additive with *not...and* prejacent disallows *not...or* antecedent:**

- a. Mira doesn't teach (both) Arabic and Basque. (*not > and*)
 ✓ [Nina]_F **also** doesn't teach (both) Arabic and Basque. (*not > and*)
 b. Mira doesn't teach Arabic or Basque.⁸ (*not > or*)
 # [Nina]_F **also** doesn't teach (both) Arabic and Basque. (*not > and*)

The same effect of the strengthening by indirect SI on the felicity of *also* is also seen with *all* under negation in (17) below:

(17) **Additive with *not...all* prejacent disallows negative indefinite antecedent:**

- a. Mira doesn't teach all of these five languages. (*not > all*)
 ✓ Nina **also** doesn't teach all of them. (*not > all*)
 b. Mira doesn't teach any of these five languages.⁹ (*not > any*)
 # Nina **also** doesn't teach all of them. (*not > all*)

We consider three possible parses which differ in the position of *exh*, illustrated with the second sentences in (16). In (18a), *exh* scopes above *also*, which incorrectly predicts (16b) to be felicitous. We also rule out parse (18c) based on the fact that *exh* is vacuous underneath negation.

- (18) a. ***exh*** [***also*** [*not* [$A_{\text{Nina}} \wedge B_{\text{Nina}}$]]]
 = ***also*** [$\neg [A_{\text{Nina}} \wedge B_{\text{Nina}}]$] \wedge \neg ***also*** [$\neg [A_{\text{Nina}} \vee B_{\text{Nina}}]$]
 $\overset{\text{ALSO}}{\rightsquigarrow} \neg(A_x \wedge B_x) \wedge \neg(A_y \vee B_y)$ for salient individuals x, y
 (not satisfied in (16a); satisfied by Mira in (16b))
 b. ***also*** [***exh*** [*not* [$A_{\text{Nina}} \wedge B_{\text{Nina}}$]]]
 = ***also*** [$\neg [A_{\text{Nina}} \wedge B_{\text{Nina}}]$] \wedge $\neg [\neg [A_{\text{Nina}} \vee B_{\text{Nina}}]$]]
 = ***also*** [$\neg [A_{\text{Nina}} \wedge B_{\text{Nina}}]$] \wedge [$A_{\text{Nina}} \vee B_{\text{Nina}}$]]
 $\overset{\text{ALSO}}{\rightsquigarrow} \neg(A_x \wedge B_x) \wedge (A_x \vee B_x)$ for a salient individual x
 (satisfied by Mira in (16a); not satisfied in (16b))
 c. ***also*** [*not* [***exh*** [$A_{\text{Nina}} \wedge B_{\text{Nina}}$]]] \Rightarrow *exh* is vacuous.
 $\overset{\text{ALSO}}{\rightsquigarrow} \neg(A_x \wedge B_x)$ for a salient individual x
 (satisfied by Mira in both (16a) and (16b))

8 Or alternatively: *Mira teaches neither Arabic nor Basque.*

9 Or alternatively: *Mira teaches none of these five languages.*

(18b) is the parse which correctly predicts the contrast in (16). *Exh* just above negation will generate the indirect SI within the scope of *also*, making the additive require that some other individual teaches either Arabic or Basque but not both, which is supported by the *not > and* antecedent in (16a), with its own indirect SI, but not by the *not > or* antecedent in (16b).

The three scope configurations considered in (18) above correspond to positions ①, ②, and ③ in (19) below. The data above shows that *exh* must be in position ②.

(19) (① **exh*) [TP [Nina]_F [*also* [(② ✓*exh*) [*not* [(③ **exh*) [vP teach [A. and B.]]]]]]]]

This data point serves to clarify the nature of the “as low as possible” generalization in (9). Adjunction of *exh* does not simply target the lowest constituent of propositional type that contains the SI trigger; instead, it must target the lowest possible position where the addition of *exh* is not vacuous. This too echoes the behavior of overt focus particles whose vacuous application is banned, as described in Crnić 2011a: 110, 2011b: 7, Alxatib 2020: 44–51, and Erlewine & New 2021.

We conclude that *and* and *all* pattern with *or* and *some*, as well as bare numerals, in requiring *exh* to adjoin as low as possible while making a meaningful contribution.

2.4 Again

The presupposition trigger *again* can also be used to diagnose the position of *exh*. Here we assume for simplicity that *again* adjoins to a node of propositional type and presupposes that the proposition held at a past time.¹⁰ Here we concentrate on repetitive uses of *again* (rather than restitutive uses) and assume that *again* adjoins to vP (see e.g. von Stechow 1996; Beck & Johnson 2004).

We begin by considering the interaction of bare numerals and unstressed *some* with the presupposition of *again*. The question is whether the presupposition of *again* can be satisfied by an antecedent description of a past event that is logically stronger than the prejacent. Examples (20a,b) show that this is not possible, again suggesting that *exh* must adjoin as low as possible above the SI trigger and therefore applies within the scope of *again*.

(20) **Again with bare numeral and *sm* disallow stronger antecedent:**

- a. Last week, Laura borrowed five books.
This week, she borrowed four books **again**.
- b. Yesterday, Timmy ate all of his broccoli.
Today, he ate sm of his broccoli **again**.

¹⁰ More formally, *again* may be described as taking an event description as its sister and presupposing that a distinct event with the same description held at a past time; see e.g. Beck & Johnson 2004.

Note that here we do not present corresponding examples with the SI triggers in subject position, above *again*, as we did when establishing the height of *exh* with respect to *also* above. This is because the presupposition of *again* is known to independently allow for mismatched subjects under certain conditions; see Bale 2007 and Smith & Yu 2022 for discussion.

Indirect SI introduced by *all* under negation can also lead to strengthening of the presupposition of *again*. In (21a,b) below, we consider the surface scope (*not* > *all*) readings with *again* taking scope over negation in the second sentences.

(21) ***Again* with *not...all* prejacent disallows negative indefinite antecedent:**

Context: Every year, Mary teaches a different group of students.

- a. Last year, Mary didn't pass all of her students. (*not* > *all*)
✓ This year, she didn't pass all of her students **again**. (*again* > *not* > *all*)
- b. Last year, Mary didn't pass any of her students.¹¹ (*not* > *any*)
This year, she didn't pass all of her students **again**. (*again* > *not* > *all*)

In (21b), the complement of *again* contains *not...all*, which is entailed by the first sentence with *not...any*. However, *exh* adjoins in the lowest position where it is not vacuous, as per our discussion above, and therefore applies just above *not*, in the scope of *again*. The presupposition of *again* then requires a prior event where Mary passed some but not all students, which is supported in (21a) but not in (21b).¹²

However, a complication arises when we attempt to use *again* to diagnose the height of *exh* with respect to disjunction. As discussed above based on evidence from additives, we predict *exh* to be positioned as low as possible, thus scoping below *again* in (22) and predicting it to be infelicitous with a conjunctive antecedent. However, we have found that there is some variation in the judgements for (22):

(22) **Speaker variation in examples with *again* and disjunction:**

Yesterday, Masa ate an apple and an orange.

% Today, he ate an apple or an orange **again**.

¹¹ Or alternatively: *Mary passed none of her students.*

¹² The context in (21b) also does not support a parse of the second sentence with *again* taking scope under negation. Such a parse is available, explaining the felicity of (i):

(i) Last year, Mary failed all of her students. ✓ (But) this year, she didn't fail all of them again.

Note that *all* under negation leads to the introduction of the indirect SI that Mary passed some students, but this SI is introduced by *exh* above negation, as predicted by our proposal, and therefore does not affect the presupposition of *again* in (i).

We hypothesize that this pattern of judgments reflects a difference between speakers in the availability of including *again* in Conjunction Reduction (possibly a form of gapping; see e.g. Hirsch 2017). In other words, speakers who judge (22) to be felicitous may be accessing a parse where *again* is part of a verb phrase disjunct, as in (23). This parse indeed predicts *again* to be felicitous with the conjunctive antecedent.

(23) He [ate an apple (*again*)] or [ate an orange *again*].

3 Variation by SI trigger

Having established that various English SI triggers require *exh* to adjoin as low as possible, in this section, we discuss the possibility of SI triggers which do not exhibit this behavior and instead allow for more delayed exhaustification.

3.1 Scalar adjectives

As S&S also note, scalar adjectives (e.g. *cold* \rightsquigarrow *not freezing*) do not require *exh* to scope within clausemate additives, as in example (24a), reproduced from their p. 512.¹³ Example (24b) shows the same with *again*, with the adjective *unhappy*. Both of (24a,b) invite their strengthened interpretations: it's cold but not freezing in Paris; today she was unhappy but not furious. This strengthening must then be due to *exh* adjoining above *also* and *again*.

(24) **Scalar adjectives allow *exh* to scope above additives and *again*:**

- a. It's freezing in New York. ✓ It's {**also**} cold in Paris, {**too**}.
- b. Jane was furious yesterday. ✓ Today, she was unhappy **again**.

We furthermore present example (25), modeled after (24a) but with the scalar adjective in an embedded clause. The felicity of *also* with a stronger antecedent in (25) suggests that the adjunction of *exh* may be delayed arbitrarily, even outside of the SI trigger's local clause. We conclude that scalar adjectives do not impose any restrictions on the position of *exh*.

(25) Ali expects that it will be freezing in Boston.
 ✓ [Brie]_F **also** expects that it will be cold there.

¹³ We also give an *also* variant of (24a), which is also felicitous.

3.2 Stressed *SOME*

We showed above that unstressed *some* (*sm*) requires *exh* to adjoin as low as possible, as diagnosed with *also* and *again*. Here in (26) we repeat these examples but with just one change, stressing *some* (*SOME*), and the results are now felicitous.¹⁴ Following the logic above, this shows that *exh* is allowed to adjoin outside of the scope of *also* and *again* in (26a,b).

(26) ***Exh* may scope above *also* and *again* with stressed *SOME*:**

- a. Evy wrote to all of the students.
✓ [Fran]_F **also** wrote to SOME of the students. (cf 14a)
- b. Yesterday, Timmy ate all of his broccoli.
✓ Today, he ate SOME of his broccoli **again**. (cf 20b)

Our description of this contrast between unstressed *sm* and stressed *SOME* is supported by another data point discussed in S&S and Marty & Romoli 2021 (M&R), reproduced in (27). A factive complement may include *SOME* but not *sm* where its strengthening to “some but not all” within the embedded clause conflicts with the common ground.¹⁵

(27) ***Exh* for *SOME* (but not *sm*) may escape the embedded clause:**

Common ground: All of the students passed.

- a. # John is aware that *sm* of the students passed.
- b. ✓ John is aware that *SOME* of the students passed.

(from M&R p. 257, following discussion in S&S p. 481)

If *exh* applies within the complement of *aware*, we predict a presupposition that some but not all the students passed, which would be infelicitous in this context. This explains the infelicity of (27a), as *sm* requires *exh* to adjoin as low as possible above it and therefore within the embedded clause. In contrast, with *SOME* in (27b), the introduction of *exh* can be delayed. With *exh* adjoining in the matrix clause, we yield the correct reading of (27b): *aware* then presupposes only that some of the students passed — unstrengthened and thereby compatible with the context in (27)

14 To our ears — as native speakers of Singaporean and American Englishes — the contrast between *sm* and *SOME* in these examples is clear. However, we have observed some speaker variation in the strength of this contrast amongst other speakers that we have consulted.

15 The discussion in S&S and M&R however has a different focus, as they are particularly interested in the unacceptability of the corresponding utterance with *unaware*, which we do not address here. See Chow 2021 for further discussion.

— and we convey that John was aware that some students passed but unaware that all students passed.

It is however not the case that the position of *exh* for *SOME* is completely free. *SOME* in an embedded finite clause with *also* in a higher clause is infelicitous:¹⁶

(28) ***Exh* for embedded *SOME* must apply within higher clause *also*:**

Evy expects that she'll see all of the students.

[Fran]_F **also** expects that she'll see SOME of them.

We hypothesize that *SOME* allows its associated *exh* to adjoin just above the verb that embeds the clause containing *SOME*, i.e. just above *expect* in (28), but no higher.

Interestingly, Klinedinst & Rothschild (2011) and Uegaki (2015) propose precisely this placement for *exh* for question-embedding verbs. Consider example (29) below in a context where Cara and Dana and no others came.

(29) **An argument for *exh* just above question-embedding verbs:**

At least one student predicted who came. (Klinedinst & Rothschild 2011: 16)

The attested, so-called intermediately-exhaustive reading requires that at least one student correctly predicted that Cara came and Dana came and made no incorrect predictions about other individuals coming. This is derived by *exh* (or a similar operator, which Uegaki calls X) applying just above *predict*. If *exh* instead applied to the entire structure, above *at least one student*, we would predict a reading that requires that no student made any false prediction, which is unattested.¹⁷

Uegaki concludes that there are two challenges to unifying the derivation of exhaustivity in embedded questions with general purpose exhaustivity effects, as in SI calculation: “One is the restriction on the scope of exhaustification discussed above. The scope of EXH is generally not limited syntactically” (p. 100). On the contrary, our results here show that the syntactic placement of *exh* is often constrained, with one variant of this restriction — observed with stressed *SOME* — allowing *exh* specifically just above an embedding verb but no higher. This suggests that there may yet be hope for reconciling the form of exhaustification necessary for the readings of embedded questions with the general syntax/semantics of *exh* in SI calculation. We leave the full investigation of this possibility for future work.

¹⁶ We furthermore observe a contrast between *SOME* in a non-finite versus finite embedding, with (i) below more acceptable than (28) to our ears.

(i) Evy hopes to meet all of the students. ✓ [Fran]_F also hopes to meet SOME of the students.

¹⁷ See also Uegaki 2015 p. 98 for an additional argument from the adverb *frequently*.

3.3 Proposal

We now present a formal analysis to account for the attested variation among different SI triggers in the requirements they impose on the placement of *exh*. Our proposal involves syntactic feature-checking: following Chierchia 2013, we propose that SI triggers bear syntactic features to ensure the presence of appropriate covert operators.

First, we propose a “strong” [*uexh**] feature which requires that *exh* be adjoined as soon as possible (while applying non-vacuously), ensuring the generalization in (9).¹⁸ Once checked, [*uexh**] imposes no conditions on the placement of additional *exh*, which will be important in section 4. Second, we propose a non-strong variant, [*uexh*], which is borne by stressed *some*. Syntactic feature-checking is customarily subject to various locality constraints; following the discussion in the section above, we take [*uexh*] to need to be checked within the local finite clause or just above its embedding verb. Finally, scalar adjectives bear no such *exh*-related feature, allowing for optional adjunction of *exh* at any height. We summarize this classification in (30):

(30) **Feature specifications for English SI triggers in this study:**

- a. [*uexh**] — *or*, bare numerals, unstressed *some* (*sm*), *and*, *all*
- b. [*uexh*] — stressed *some* (*SOME*)
- c. [—] — scalar adjectives

The classification and proposal here offer a first step in using interactions with presupposition triggers to investigate the precise placement of *exh* with different SI triggers, under different circumstances. We note that there are English SI triggers that we have not discussed, such as superlative modified numerals and mid-scale items such as *many* and *most*; we leave their classification for future work.

4 Ignorance implicatures

In this section, we discuss how our proposal for the placement of *exh* extends to the derivation of ignorance implicatures, following the discussion in Marty & Romoli 2021 (M&R). In particular, we will show that our feature-checking proposal in section 3.3 correctly predicts the possible parses in cases involving multiple instances of *exh*. Furthermore, we show that there are cases in which the correct

¹⁸ In (90’s era) Minimalist syntax, “strong” features are posited to enforce overt movement, originally described as requiring checking before Spell-Out (Chomsky 1995: 181ff). Our interpretation of “strength” here reflects the intuition expressed as in Sauerland 1995 to recast “strong” features as expressing a violable preference for early satisfaction, as in Pesetsky 1989. See also Erlewine 2015b for discussion of other approaches such “as low as possible” requirements on particle placement.

derivation of ignorance implicatures requires the insertion of a covert necessity operator in embedded positions, contra Meyer’s (2013) “Matrix K” theory.

Disjunction often introduces ignorance implicatures with respect to the truth of individual disjuncts, in addition to the “not and” SI discussed above. Such ignorance implicatures are argued to result from the presence of *exh* above a covert speaker-oriented doxastic necessity modal \Box (Chierchia 2013; K in Meyer 2013). Consider the derivation of both types of implicatures in example (31) below. Here again, we take A_x and B_x to stand for propositions ‘that x teaches Arabic’ and ‘that x teaches Basque’ respectively. *Exh* applying directly to the disjunction produces the SI that Nina does not teach both languages, as we discussed above. An additional *exh* above \Box then produces the ignorance implicatures that the speaker doesn’t know whether Nina teaches Arabic and doesn’t know whether Nina teaches Basque.

(31) **Deriving SI and ignorance implicatures with multiple *exh*:**

Nina teaches Arabic or Basque.

$$\begin{aligned} & \textit{exh} \Box [\textit{exh} [A_{\text{Nina}} \vee B_{\text{Nina}}]] \\ &= (A_{\text{Nina}} \vee B_{\text{Nina}}) \wedge \underbrace{\neg(A_{\text{Nina}} \wedge B_{\text{Nina}})}_{\text{scalar implicature}} \wedge \underbrace{(\neg\Box A_{\text{Nina}} \wedge \neg\Box B_{\text{Nina}})}_{\text{ignorance implicature}} \end{aligned}$$

We now consider the interaction of these implicatures with an additive particle, *also*. Schematically, we consider three possible parses in (32) below. Note that, as per our discussion above (especially section 2.1), we take these three parses to reflect different options for the placement of *exh* and \Box in a syntactic structure with *also* in a fixed position; we return to this point below.

(32) [Nina]_F **also** teaches Arabic or Basque.

- a. *also* [*exh* \Box [*exh* [$A_{\text{Nina}} \vee B_{\text{Nina}}$]]]
- b. *exh* \Box [*also* [*exh* [$A_{\text{Nina}} \vee B_{\text{Nina}}$]]]
- c. *exh* \Box [*exh* [*also* [$A_{\text{Nina}} \vee B_{\text{Nina}}$]]]

Empirically, M&R discuss four types of antecedents for (32), reporting the pattern of judgments as in (33) below:¹⁹

¹⁹ Just as S&S do, M&R use postnominal *too* as their additive particle in their examples. Again, we prefer and advocate for the use of *also*, as this allows for the clear determination of the position of additive semantics, as discussed in section 2.1 above. *Also* is also often more natural to our ears than their *too* counterparts, as we note in footnote 3.

As we showed in section 2 above, the consideration of SI alone allows for an explanation for the contrast between the disjunctive and conjunctive antecedents in (33a,b) below. However, we did not discuss the “simple” and “split” antecedent types there, because — as M&R argue (pp. 261ff.) — accounting for these behaviors requires consideration of ignorance inferences.

- (33) **Additive with disjunctive prejacent, with four types of antecedents:**
- a. Mira teaches Arabic or Basque. *disjunctive antecedent*
 ✓ [Nina]_F **also** teaches Arabic or Basque. =(3a)
 - b. Mira teaches Arabic and Basque. *conjunctive antecedent*
 # [Nina]_F **also** teaches Arabic or Basque. =(3b)
 - c. Mira teaches Arabic. Ora teaches Basque. *“split” antecedent*
 ✓ [Nina]_F **also** teaches Arabic or Basque.
 - d. Mira teaches Arabic. *“simple” antecedent*
 # [Nina]_F **also** teaches Arabic or Basque.

Based on this data, M&R (pp. 269–271) illustrate in detail the need for both parses in (32a,b). Parse (32a), repeated in (34) below, straightforwardly predicts both the SI and ignorance implicature in (31) to contribute to the content of the additive particle. This parse predicts the acceptability of the disjunctive antecedent example in (33a), but does not allow for any other type of antecedent.

$$(34) \quad \text{also} [\text{exh} \square [\text{exh} [A_{\text{Nina}} \vee B_{\text{Nina}}]]] \quad = (32a)$$

$$\overset{\text{ALSO}}{\rightsquigarrow} (A_x \vee B_x) \wedge \neg(A_x \wedge B_x) \wedge (\neg \square A_x \wedge \neg \square B_x) \text{ for salient individual } x$$

However, as M&R observe, disjunction in the scope of an additive is also grammatical with what they call a “split” antecedent as in (33c). This is not predicted to be felicitous by the parse in (32a/34) and instead requires the parse in (32b), repeated in (35). M&R show that this parse results in additional additive requirements, that there is a salient individual that teaches Arabic but not Basque as well as a salient individual that teaches Basque but not Arabic.

$$(35) \quad \text{exh} \square [\text{also} [\text{exh} [A_{\text{Nina}} \vee B_{\text{Nina}}]]] \quad = (32b)$$

$$\overset{\text{ALSO}}{\rightsquigarrow} (A_x \vee B_x) \wedge \neg(A_x \wedge B_x) \wedge \underbrace{(A_y \wedge \neg B_y) \wedge (\neg A_z \wedge B_z)}_{\text{unpacking higher } exh} \text{ for salient } x, y, z$$

Here we do not reproduce the details of this calculation but refer the reader to M&R’s discussion in pp. 269–270, especially around their (85). This parse allows for the felicitous use of the split antecedent example in (33c), but predicts infelicity in all other cases in (32). In particular, the felicity of both disjunctive and split antecedents (33a,c) requires the grammar to entertain both parses in (32a,b).

M&R however do not discuss the parse in (32c), repeated in (36) below, although nothing in their discussion would lead us to independently rule it out. Recall from section 2 that, as S&S note (p. 511), a parse with no *exh* below *also* but *exh* taking *also* in its scope will lead to a conjunctive additive presupposition that some salient individual teaches both Arabic and Basque.

$$(36) \quad (exh \square) [exh [also [A_{Nina} \vee B_{Nina}]]] \quad = (5), (32c)$$

$$\overset{ALSO}{\rightsquigarrow} (A_x \vee B_x) \wedge (A_y \wedge B_y) \text{ for salient individuals } x, y$$

In reality, however, a conjunctive antecedent does not support the felicitous use of the additive, as seen in (33b). This shows that the parse in (32c/36) must be blocked by the grammar. This was the crucial data point that motivated our description for *exh* being as low as possible in section 2 above.

Let us return now to the different possible parses in (32), repeated here in (37). M&R have argued that parses (a) and (b) must be available, and to this we add the observation that parse (c) must be blocked.

- (37) [Nina]_F **also** teaches Arabic or Basque.
- a. ✓ **also** [*exh* □ [*exh* [A_{Nina} ∨ B_{Nina}]]] =(34)
 - b. ✓ *exh* □ [**also** [*exh* [A_{Nina} ∨ B_{Nina}]]] =(35)
 - c. * *exh* □ [*exh* [**also** [A_{Nina} ∨ B_{Nina}]]] =(36)

Having established this pattern of grammatical and ungrammatical parses in (37), we now discuss two consequences of these facts.

First, the pattern of grammaticality in (37) is explained by — and in turn further supports — the feature-checking proposal for restricting the position of *exh* that we put forward in section 3.3 above. Disjunction bears the strong [u*exh**] feature which must be checked by the adjunction of *exh* as low as possible above the trigger; however, once *exh* has checked the [u*exh**] feature on the trigger, it does not constrain the position of higher *exh*. This explains the flexibility of the adjunction site of the higher *exh*, allowing for both parses (37a) and (37b), while correctly ruling out the unattested (37c) parse which M&R (and S&S) would otherwise overgenerate.

Second, the necessity of parse (37a), together with our discussion of the scope of *also* above, has an important consequence for the source of ignorance inferences and the nature of the covert necessity operator involved (here, □). M&R’s discussion is couched in terms of Meyer (2013)’s “Matrix K” proposal, where ignorance inferences are generated by *exh* applying over K (corresponding to our □) which always adjoins to the clause root. The discussion in M&R then assumes (with S&S) that additives may be interpreted high, at or near the edge of the clause, including above Meyer’s K; see M&R’s (87), which corresponds to our (37a). However, as we showed in section 2.1 above, *also* takes scope in its pronounced position, rather than some abstract, higher position at the edge of the clause. The necessity of the parse in (37a) thus requires K/□ to be adjoined to a clause-medial position, as shown in (38):

$$(38) \quad [_{TP} [Nina]_F [\text{also} [\text{exh} [\square [\text{exh} [_{VP} \text{teaches [Arabic or Basque]]]]]]]]]]]$$

↑

This therefore forms an argument against Meyer’s “Matrix K” theory, and instead supports the view that the covert necessity operator involved in the derivation of ignorance implicatures (\square) may occur in embedded positions. While this possibility has been assumed in some prior work on ignorance implicature calculation such as Chierchia 2013 and Mihoc 2019, to our knowledge, it had not been described as a significant empirical advantage of the embedded \square approach.

The possibility of introducing ignorance inferences in embedded positions is also necessary for capturing the felicity of *also* in embedded clauses, whose content is affected by ignorance implicatures. For example, consider example (39) below:

(39) **Additive with disjunctive prejacent, in an embedded clause:**

Mira teaches Arabic. *“simple” antecedent*
There’s a rumor that [Nina]_F **also** teaches Arabic or Basque.

The infelicity of (39) with a simple antecedent must be due to ignorance inferences being calculated within the scope of *also*; if only the SI is introduced, strengthening the prejacent of *also* to include “but not both,” its presupposition should be satisfied in the context. This too strengthens the argument against the Matrix K theory.²⁰

5 Conclusion

In this paper, we explored the use of additives and *again* to pinpoint the syntactic position of *exh*, which introduces SI. Our results offer new support for the grammatical approach to SI calculation, showing that SI — as well as ignorance implicatures — may be introduced in embedded positions.

At the same time, a longstanding challenge for the grammatical theory of SI has been the notion of *exh* itself: an invisible focus particle akin to *only*, with apparently rather flexible distribution (see e.g. discussion in Geurts 2013). What we see here is that the distribution of *exh* is in fact severely restricted, and in a manner that echoes documented “as low as possible” and non-vacuity restrictions on the placement of overt focus particles. The existence of such *structural* parallels in the distribution of *exh* and overt focus particles supports the conceptual plausibility of *exh* itself. We hope our discussion here may pave the way towards a deeper understanding of the nature of *exh* in grammar and in the typology of focus particles.

²⁰ The specific proposal in Meyer 2013 is to “Attach K_x to every assertively used sentence ϕ ” (p. 42). We could perhaps imagine K applying to certain embedded, root clauses that have the status of embedded assertions. However, the complement of *a rumor* certainly does not have this status.

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