Intermediate Scalar Implicatures*

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Abstract

Several recent works have debated the question whether scalar implicatures should be accounted for in the semantics or the pragmatics of sentences. Sauerland (2012, Lang. and Ling. Compass) mentions that cases of Intermediate Implicatures provide a novel argument for a semantic account of scalar implicatures. Intermediate implicatures take scope between two quantificational operators occurring in the same sentence whereas local implicatures scope below all quantificational operators and global implicatures scope above all operators. Therefore, intermediate implicatures require an account within the sentence semantics. In this paper, we explicate Sauerland's 2012 argument and explore further data. These data corroborate that intermediate implicatures exist both with the scalar terms "some", "and", and "or" and with numerals. For the latter, I defend the intermediate implicature account against an analysis (Kennedy 2013, Cambridge University Press) that uses syntactic movement of a maximalization operator.

1 Introduction

In this paper, I am concerned with the explanation of scalar implicatures; specifically, with the question whether scalar implicatures should be explained in the pragmatics or in the

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Salvatore Pistoia-Reda (ed.), Palgrave: 1–23

semantics of a sentence. In this discussion, I use the terms *implicature* and *scalar implicature* simply as labels for a certain range of facts. Grice (1967, 1975, 1989) introduced the term *implicature* for a variety of cancellable inferences and simultaneously suggested an explanation of implicatures on the basis of his maxims – a pragmatic explanation. Horn (1972) extended this type of account to scalar implicatures. However, many in the field (e.g. Levinson 2000, Chierchia 2002) have already used Grice's and Horn's term as descriptive labels for a range of phenomena, without commitment to specific type of explanation, as I will in the following.

Two core examples of scalar implicatures are existential quantifiers and disjunction. An example with an existential quantifier, the determiner *some*, is (1), and an example with the disjunction *or* in (2).[1] The relevant scalar impliature of (1) is the inference that not all of the contributions talk about implicatures, and (2) implicates that not both Maya and Luca talked about implicatures.

(1) *Some* of the contributions talk about implicatures.

(2) Maya *or* Luna talked about implicatures.

As I mentioned already, the goal of the paper is to compare a pragmatic and a grammatical (semantic) explanation of the scalar implicatures in (1) and (2). For concreteness, I refer to the pragmatic explanation I formulated in earlier work (Sauerland 2004b) which built primarily on Gazdar 1979 and Horn 1989. As the semantic explanation, I assume the specific proposal of (Fox 2007) (see also Chierchia 2004, Chierchia et al. 2012). Both explanations take for granted that listeners relate the lexical items *some* and *or* as well as many others to alternatives that are structurally no more complex than lexical items as Katzir (2007), Fox and Katzir (2011) propose. Specifically relevant for the following is that *all* is an alternative of *some* and *and* is an alternative of *or*. At the phrasal level, alternatives are derived from the lexical alternative sets via a procedure described by Katzir (2007). Each step of the procedure consists of either replacing a lexical item with an alternative or of omitting a constituent. As a result, an alternative of (1) is the sentence *All of the contributions talk about implicatures*. For (2), one alternative is the sentence *Maya and Luna talked about implicatures*.[2] While the alternatives play a role in both explanations, the roles they play differ in the two analyses.

The pragmatic analysis assumes that the alternatives are relevant to the pragmatic maxims of Grice (1989). Grice's maxim based concept of implicature is tied to speech acts, in particular the act of making an assertion. Of the four Gricean maxims, Quality, in particular, cannot apply at levels other that of a full speech act at least as Grice stated the principle: *Try to make you contribution one that is true.* Parts of a sentence generally

[1]Here and in the following, I mark scalar terms with italics.

[2]Two other alternatives, *Maya talked about implicatures* and *Luna talked about implicatures* can be derived by omission of constituents. However, these won't play any role in the following, and therefore I ignore them in this paper. The role of these alternatives is discussed by Sauerland (2004b) and Fox (2007) among others.

aren't true: In the compositional semantics of a sentence, parts of a sentence can be of a type other than truth values. Furthermore, truth valued sentence parts can be embedded in an environment such that the entire sentence can be felicitously asserted even when a particular sentence part isn't true; specifically, in the scope of a downward entailing or other non-veridical operator.[3] Therefore, the quality maxim can only apply at the structural level of an assertion. The specific pragmatic analysis I adopt assumes that Grice's weaker first maxim of quality is relevant, and that this maxim can be captured as a speaker may assert proposition p only if the speaker is certain that p holds. The first quality maxim interacts with Grice's first quantity maxim and the set of alternatives, to derive the following: for any alternative p to the actual assertion q, if p is asymmetrically entailed by q, the speaker isn't certain the p holds. Specifically, this derives that a speaker asserting (1) must not be certain that the alternative *All of the contributions talk about implicatures* holds. Furthermore, Sauerland (2004b) adopts the assumption of that hearers generally attribute competence to speakers: the assumption that speakers are certain that p holds or that p doesn't hold for any alternative p to an assertion they make. This assumption derives that a speaker asserting (1) must be sure that not all of the contributions talk about implicatures. In a similar fashion it follows that a speaker asserting (2) must be sure that not both Maya and Luna talked about implicatures.

The grammatical analysis assumes that the alternatives are relevant to a semantic exhaustification operator, which I will indicate as **exh** following Fox 2007 (Chierchia 2013 and elsewhere uses O for a related operator). The definition of the **exh** operator in (3) takes two arguments: a set of relevant alternative propositions A in addition to a single proposition q. A is given by context, but must be a subset of the set of alternatives of the complement of *exh*(A), q.[4]

$$\mathbf{exh}(A)(q)(w) = \forall p \in A\ [(p \to q \wedge q \not\to p)\ \to\ \neg p(w)] \tag{3}$$

Assuming that the alternative with *all* to (1) and the one with *and* to (2) are elements of the alternative set A for the respective example, the definition of **exh** directly derives the implicatures noted above.

The most salient difference between the pragmatic and the semantic analysis of implicatures has to do with embedding: **exh** can combine with any proposition denoting phrase within a sentence. Pragmatic reasoning, however, must be restricted to veridical environments as I noted above. This restriction of the pragmatic account was first noted by Cohen (1971), and has subsequently led to a debate of whether implicatures are *local* or *global* (Chemla and Spector 2011, Chierchia 2004, Chierchia et al. 2009, 2012, Gajewski and Sharvit 2012, Geurts and Pouscoulous 2009, Geurts 2009, Russell 2006, Sauerland 2004a, 2010). However, this debate has up to now focused on examples where an implicature trigger interacts scopally with one quantificational operator. For example, recently,

[3] An operator O is downward entailing if $p \to q$ entails $Oq \to Op$. O is veridical if $Op \to p$.

[4] Here and in the following, I adopt two notational conveniences: (i) I generally don't draw the distinction between a syntactic representation of a proposition and the proposition it denotes, i.e. in (3) p, q stand for either, and (ii) I apply material implication $\to$ to propositions $p \to q$ as a shorthand for $\forall w \in \text{domain}(p) \cap \text{domain}(q)\ (p(w) \to q(w))$.

Chemla and Spector (2011) argue that examples like (4) allow an interpretation corresponding to 'local' placement of **exh** in the scope of the quantificational subject.

(4) Exactly one letter is connected with *some* of its circles. (Chemla and Spector 2011, p. 383)

Two possibilities for the placement of **exh** are shown in (5). (5a) represents the local reading where the scalar implicature is part of the scope of quantifier *exactly one letter*. Representation (5b), however, results in the same reading that also the pragmatic approach to scalar implicatures predicts: This interpretation can be paraphrased as "Exactly one letter is connected with at least some of its circles and it's not the case that exactly one letter is connected to all of its circles.".

(5) a. Exactly one letter λ_x **exh** [x is connected with *some* of its circles]
b. **exh** [Exactly one letter λ_x x is connected with *some* of its circles]

Interpretation (5a) is weaker than (5b), and also not entailed by the literal interpretation of (4). The experimental results of Chemla and Spector (2011) show that sentence (4) is frequently accepted in scenarios where only reading (5a) is true. This result argues for the presence of a representation other than (5b) and the literal interpretation.

However, Chemla and Spector's result can also be captured by the assumption that *some* is lexically ambiguous between a weak, lower-bounded reading and stronger, upper-bounded reading in the lexicon (Sauerland 2012). The two generalized quantifier meanings in (6a) and (6b) would capture these two meanings.

(6) a. $[\![\text{some}_\text{w}]\!] = \lambda P \in D_{\langle e,t\rangle} \lambda Q \in D_{\langle e,t\rangle} P \cap Q \neq \emptyset$
b. $[\![\text{some}_\text{s}]\!] = \lambda P \in D_{\langle e,t\rangle} \lambda Q \in D_{\langle e,t\rangle} P \cap Q \neq \emptyset \wedge P \cap Q \neq P$

Already Grice (1989) consideres such an ambiguity proposal, though for other data. Grice ultimately dismisses such an approach on conceptual grounds. Specifically, he calls the underlying conceptual principle as the *modified Ockham's razor*, which he states as: *Senses are not to be multiplied beyond necessity.* However, this principle could be reconsidered to accommodate evidence such as that of Chemla and Spector (2011) within the pragmatic theory. On such an account, the scalar inferences in (1) can be derived in two ways: either by the lexical item (6b) or by (6a) and the pragmatic mechanism. The account would need to be generalized to other triggers of scalar implicatures, as I point out in Sauerland (2012). However, such a general pragmatic + lexical account to implicatures is easy to state. For example for *or*, a lexical ambiguity between inclusive and exclusive *or* would need to be assumed. With this amendment, the pragmatic + lexical approach and the grammatical approach to scalar implicatures make the same predictions for examples where a scalar term occurs in the scope of a single quantification operator: both predict the existence of global and local implicatures.

For this reason, a second difference in prediction between the pragmatic account and the grammatical account of scalar implicatures is interesting. This concerns what I call

Intermediate Implicatures in Sauerland (2012) (see also Spector 2013a). Specifically, this difference is predicted to be testable in structures where a scalar item occupies a position in the scope of two quantificational operators. As we saw above, if there is only one quantificational operator, the grammatical approach predicts that **exh** can be placed above or below this one operator resulting in the global and local interpretation. But if there are two quantificational operators, three structures with a single **exh** operator are predicted to exist. As shown schematically in (7), **exh** could take global, intermediate or local scope.[5]

(7) a. [**exh** ... [Q1 ... [Q2 ... *scalar item* ...]]] (*global*)
b. [Q1 ... [**exh** ... [Q2 ... *scalar item* ...]]] (*intermediate*)
c. [Q1 ... [Q2 ... [**exh** ... *scalar item* ...]]] (*local*)

Of the three readings predicted by the grammatical account, the pragmatic account directly predicts only the global reading (7a). Furthermore, the local reading (7c) is also predicted by the pragmatic + lexical account. However, the intermediate reading (7b) seems difficult to accommodate within the pragmatic account. For this reason, I started to investigate the availability of the intermediate implicature reading in (Sauerland 2012), and concluded that especially examples involving modals and numerals provide evidence for the existence of intermediate implicatures.

In the remainder of this paper, I summarize and update the case for the existence of intermediate implicatures. In section 2, I give an overview of the range of cases where intermediate implicatures can be expected. In section 3, I discuss the most controversial case – that of numerals in the scope of modals – in the light of recent work by Kennedy (2013b,a). Kennedy proposes an account of numeral-modal interactions based on the assumption that numerals inherently involve a maximization operator that can be assigned flexible scope. I, however, show that the scopal behavior of intermediate implicatures in this case is better explained by assuming that a silent **exh** can be base generated. The last section concludes the paper.

2 Intermediate Implicatures above Downward Entailing Operators

Initially, it is not clear how difficult it is to probe for the predicted intermediate implicatures. But, given the extended debate concerning local and global implicatures that I mentioned above, it is unsurprising to me that intermediate implicatures are at least as difficult to demonstrate reliably. However, the task is made considerably easier by the knowledge gained from the discussion of local vs. global implicatures. Note that the role of the higher quantifier Q1 in (8a) for the targeted intermediate implicature is similar to that of the only quantifier Q in (8b) for the local implicature.

(8) a. [Q1 ... [**exh** ... [Q2 ... *scalar item* ...]]] (*intermediate with two Q.*)
b. [Q ... [**exh** ... *scalar item* ...]] (*local with one Q.*)

[5] I focus on structures containing just one **exh**, but leave it open whether there can be further readings. See especially (Meyer 2013) for relevant discussion.

The quest for decisive evidence for or against the existence of structures like (8b) showed that the quantifier Q ought to be neither upward nor downward entailing for the following reasons: (9) illustrates the problem with upward entailing Q. Namely, the local reading 'Everybody talked to exactly one of Maya and Luna' entails the truth of the global reading 'Everybody to at least one of Maya and Luna, but not everybody talked to both' (Sauerland 2010). It is known that in other cases of ambiguity, such an entailment relation makes it impossible to detect the logically stronger reading. Meyer and Sauerland (2009) argue for a *Truth Dominance* principle: if an ambiguous sentence S is true on its most accessible reading in a scenario, speakers must judge sentence S true in that scenario.[6] Assuming that that the global reading is more accessible for (9) of the two readings in (8), the entailment relation from the local to the global reading predicts the local reading to be impossible to detect in (9).

(9) Everybody talked to Maya or Luna.

The problem with downward entailing Q is illustrated by (10). The local reading is detectable and for example the continuation, *but Jack talked to both of them* shows that it must exist. But the local reading requires strong focus on the scalar item *or*.

(10) Nobody talked to Maya or Luna.

Note that the scalar item *some* cannot scope below a single downward entailing operator to begin with.

For these reasons, Chemla and Spector (2011) look at non-monotonic quantifiers such as *exactly one* as in example (4) above and in this way, successfully demonstrate local implicatures. A second strategy that has been successfully used to provide evidence for local implicatures has been applied by Chierchia et al. (2009). They use not purely semantic evidence for available readings, but a pragmatic constraint on the use of disjunction, *Hurford's Constraint* (see below). In the following, I consider evidence for intermediate implicatures using both of these tests that have already been successfully used to show local implicatures.

So far, we discussed the right choice of the higher quantifier Q1 in the schema in (8a) for the task of finding intermediate implicatures. In addition, we need to consider the choice of the lower quantifier Q2 in the schema in (8a). This case is in some respects the reverse of the Q1 case since it is parallel to the global implicature case with a single quantifier. The clearest case for global implicature computation in that case comes from embedding a scalar item that is maximal on its scale underneath a downward entailing operator. Maximal items do not trigger scalar implicatures when they occur in an upward entailing environment, but they do when a downward entailing operator takes scope over them (see discussion in Sauerland 2004b). For example, the scalar item *all* in (11) triggers the inference that Kai had some of the peas last night.

[6]See also Gualmini et al. (2008) for a similar *Charity* principle, and Mayr and Spector (2009) for related discussion.

(11) Kai didn't have *all* of the peas last night. (Sauerland 2004b, p. 369)

In the remainder of this section, I focus on cases of Q2 and scalar items like these. A second interesting case is provided by numerals embedded below modals. These cases, I consider in more detail in the following section.

2.1 Non-Monotonic Quantifiers as Top Quantifiers

In this section, I consider examples where *and* and *all* are embedded below negation and *exactly one*. In these cases, we expect an intermediate implicature. Interestingly there seems to be a difference between *and* and *all*: the former yields the predicted intermediate implicature while the later doesn't. Consider first the case with *and* exemplified by (12a). The representation that is predicted to give rise to the intermediate implicature is shown in (12b).

(12) a. Exactly one student didn't talk to Maya and Luna.
b. exactly one student λx **exh** [x didn't talk to Maya *and* Luna]

Interpretation (12b) is true in the following scenario: (i) there's exactly one student who talked to Maya, but not to Luna, (ii) there's at least one student who talked to both Maya and Luna, and (iii) there's also at least one student who talked to neither of the two. In this scenario, furthermore no reading of (12a) without an intermediate **exh** is predicted to be true: Since a local reading doesn't exist for (12a), consider only the literal and the global readings in (13): The literal reading and the global reading both require that all but one student talked to both Maya and Luna.

(13) a. exactly one student λ_x [x didn't talk to Maya *and* Luna] (*literal*)
b. **exh** exactly one student λ_x [x didn't talk to Maya *and* Luna] (*global*)

In my judgment the relevant reading is available for (12a) – i.e. (12a) is judged true in the scenario described in the previous paragraph. Consider also (14) in a scenario where most students either do well in math and physics, or neither of them and there's at least one student in both of these categories. In that scenario, (14) is acceptable to me. This acceptability provides evidence for the intermediate implicature reading.

(14) Exactly one student in my class didn't excel at math and physics, but only at physics.

Hence embedding of *or* provides evidence for intermediate implicatures. However, with the scalar item *all*, I have not been able to construct an example where the intermediate implicature construal is accessible in similar configurations. Consider example (15a). The predicted intermediate reading in (15b) ought to be true in a scenario where exactly one student talk to some, but not all of the professors, while some of the other students talked to all the professor and the remaining students talked to none of them. In my judgment, (15a) isn't felicitous in such a scenario.

(15) a. Exactly one student in my class didn't talk to all the professors.
b. exactly one student in my class λ_x **exh** [x didn't talk to all the professors]

At this point, I don't have an explanation for the difference I perceive between (14) and (15). A possible line on (15a) might be the one Spector (2013c) suggests for examples like (16) (see also Chierchia 2013): Spector proposes that the plural predication *read the books* in (16) is ambiguous between *read some of the books* and *read all of the books*. Furthermore, Spector suggests that the possible interpretations of a sentence aren't only its readings, but can also be conjunctions therefore. Specifically, Spector proposes that the most salient interpretation of (16) is conjunction of the two readings arising from the ambiguity of plural predication: Exactly one of the students read some of the books and exactly one of the students read all of the books. This interpretation captures the intuition that (16) entails that one student read all the books while the other students read none of them.

(16) Exactly one of these ten students read the books.

For (15a) a similar reasoning might be applicable if we assume that (15a) is ambiguous between the intermediate implicature interpretation and the literal interpretation.[7] The literal interpretation of (15a) implies that all but one student talked to all the professors, but allows that one student to have talked to none of the professors. But, the conjunction of the intermediate and literal interpretation would predict that (15a) should require that exactly one student talked to some of the professors and all the others to all of them. This prediction is corroborated by my judgment on (15a), and would therefore provide evidence for the presence of the intermediate implicature in (15a). However, Spector's suggestion of conjoining all available readings predicts that (12a) should entail that all students except one talked to both Maya and Luna. These considerations, therefore, have captured difference between *some* and disjunction with some specificity, but still haven't explained the difference satisfactorily—this I have to leave up to future work. As a summary, it is worth repeating that both test cases argue for the availability of intermediate readings, even though in two different ways.

2.2 Hurford Disjunctions as Top Quantifiers

A second argument for local readings that Chierchia et al. (2009) develop is based on Hurford's constraint (Hurford 1974, Gazdar 1979). Chierchia *et al.* propose that the difference in acceptability between (17a) and (17b) is explained by the presence of a local implicature in (17b). Specifically, Hurford's generalization is assumed to mark any disjunction as ill-formed where one disjunct entails the other (see Singh (2008), Meyer (2013) for attempts to derive the constraint from more general principles). This predicts (17a) to be illformed. (17b), however, should also be ill-formed if *some* could only trigger a global implicature.

[7] Recall that the literal interpretation is equivalent to the local one because **exh** is vacuous on the local interpretation.

(17) a. #John is from either France or Paris.
b. Either John is familiar with *some* of Beethoven's symphonies or with all of them.

But if the representation in (18) is available, the second disjunct doesn't entail the first—the two disjuncts are actually mutually exclusive once a local implicature is computed. Therefore Chierchia (2006) argue that the acceptability of (17b) provides evidence for local implicatures.

(18) Either [**exh** [John is familiar with *some* of Beethoven's symphonies]] or [John is familiar with all of them]

Hurford's constraint provides a second way to test for intermediate implicatures. I focus again on examples where the first disjunct contains a maximal scalar item embedded below negation. In this case, there doesn't seem to be a strong contrast between conjunction *and* and the universal quantifier *all*. Consider first conjunction in (19).

(19) $^{?}$Either Joe didn't talk to Maya and Luna or he talked to neither of them.

The prediction of the grammatical analysis is that (19) should be acceptable because of an intermediate implicature generated in the representation (20). Since the first disjunct after the application of **exh** is equivalent to Joe talked to one of Maya and Luna, it is not entailed by the second disjunct, and therefore (20) shouldn't violate Hurford's constraint. In my judgment the relevant interpretation is accessible in (19), but only when *and* is focussed.

(20) either [**exh** [Joe didn't talk to Maya and Luna]] or [he talked to neither of them].

The example with *all* shown in (21) is already presented by Sauerland (2012). In this case too, the prediction of an intermediate placement of **exh** would be that Hurford's constraint would be satisfied, and the sentence should be fully acceptable. However, (21) too is somewhat degraded and seems to be perhaps slightly more degraded than (20).

(21) $^{??}$Either Joe didn't read every book or he read no book. (Sauerland 2012)

In summary, the test for intermediate implicatures with Hurford's constraint yields a complicated result. The marginal acceptability of (19) and (21) argues that intermediate implicatures are available, but at the same time, the account leaves unexplained the marginal status of the two relevant examples. At this point, I leave this issue up to future work.

In this section, we only considered tests for intermediate implicatures using a downward entailing item (and specifically negation) as the lower quantifier, and then considered the maximal scalar items *and* and *all* as triggers for intermediate implicatures. In the next section, I discuss another case of non-local implicature, and argue that it provides further evidence for the grammatical analysis of scalar implicatures.

3 Intermediate Implicatures with Modals, Numerals, and Related Cases

In (Sauerland 2012), I considered example (22) the strongest example arguing for intermediate implicatures. In the previous section, I showed already that examples with scalar terms under negation also provide evidence for intermediate implicatures. In this section, I spell out this argument in more detail. I further consider a proposal of Kennedy (2013b,a) that uses syntactic scoping and maximization of the numeral to capture data like (22). While there is substantial overlap between the two proposals, I show that Kennedy's proposal can only cover some of the relevant data.

(22) Either she must read at least three of the books or she must read at least four of them. (Sauerland 2012)

Consider first the semantic interaction of bare numerals and modals illustrated in (23) and (24). The numerals seem to lend themselves systematically to different interpretations leading to a generalization Kennedy (2013b) traces back to Scharten (1997) (see also Breheny 2008): numerals in the scope of universal deontic modals as in (23) often have salient readings where the numeral states the minimum number required. In the scope of existential root modals as in (24), however, a salient reading is one where the numeral specifies a maximum amount.

(23) a. To qualify for this course, you must have two A grades. (Breheny 2008, p. 121)
b. The Troll had to put two hoops on the pole to win. (Musolino 2004, p. 16)

(24) a. Arnie is capable of breaking 70 on this course, if not 65. (Horn 1972)
b. She can have 2000 calories a day without putting on weight. (Carston 1988)

Kennedy (2013b) and Spector (2013a) show that the interaction can be derived from the interaction of scalar implicature computation and the semantics of modals.[8] For concreteness assume that numerals are interpreted as cardinality adjectives as in (25) following for example Hackl (2000).[9]

(25) $[\![n \text{ (many)}]\!] = [\lambda_x \,.\, \#x \geq n]$

The two examples (26) and (27) illustrate the readings predicted when **exh** associates with the numeral from a scopal position above the modal. Reading (26b) is true if two is the largest number *n* such that you have at least *n* many A grades in any permissible world. It

[8] Kennedy's account actually relies on degree maximization rather than scalar implicature computation, but the semantics is exactly the same. The earlier account of Breheny (2008) bears some similarity to the account mentioned in the text, but isn't as complete.

[9] The arguments in the following are largely independent of the precise semantics of numeral phrases, as long as in the clausal context numerals always have an *at least*-semantics. For example, we could also assume that the cardinality adjective itself requires an exact interpretation, $\#x = n$, since existential quantification over such plural individuals would then still derive an at least interpretation at the clausal level (Breheny 2008).

entails that there is a permissible world where you have two A grades, but there may also be worlds where you have more than two. Reading (27b), on the other hand, states that two is the largest number such that there is a permissible world where you have that many F grades. This is compatible with a scenario where there are other permissible worlds, where you have fewer than two F grades, but (27b) would be false if there is a permissible world where you have three F grades. In this way, the difference between stating a lower and upper limit follows from the semantics of the modal and scalar maximization.

(26) a. You must have two A grades.
b. **exh** $\Box$ [you have *two* A grades]

(27) a. You can have two F grades.
b. **exh** $\Diamond$ [you have *two* F grades

Note that both readings differ from the ones with local scope of *exh* in (28). With the universal in (26a), the local exhaustification results in the logically stronger reading (28a): (28a) entails (26b). With the existential, however, the local reading (28b) is logically weaker than the global reading (27b): (28b) requires only that there be at least one permissible world where you have exactly two F grades.

(28) a. $\Box$ **exh** [you have *two* A grades]
b. $\Diamond$ **exh** [you have *two* F grades]

Assuming the truth dominance principle of Meyer and Sauerland (2009) (see above), the global reading can therefore only be reliably detected in the case with a universal quantifier. So in the following, I focus on this case of modal-quantifier interactions that can be used to test for intermediate implicatures. Example (22) contains a modified numeral below a universal modal. At this point, the effect of the numeral modifiers *at least/at most* is discussed controversially (Nouwen 2010, Cummins and Katsos 2010, Cohen and Krifka 2011, McNabb and Penka 2013). In my judgment, the modifier is only fully acceptable if it supports the reading availabile with the bare cardinal: I.e. (29a) and (30b) are fully acceptable, while (29b) and (30a) are degraded. The experiments reported by McNabb and Penka 2013 corroborate that generally subjects are less consistent in judging (29b) and (30a).

(29) a. You must have at least two A grades.
b. ?You must have at most two A grades.

(30) a. ??You can have at least two F grades.
b. You can have at most two F grades.

While I don't have a complete account at this point, this pattern of judgment may indicate that the numeral modifier only has a secondary role in the interpretation of the sentence similar to the proposal of Cohen and Krifka (2011). Specifically, it may be that the semantic interpretation of the sentences in (29) and (29) is identical to that the sentence containing bare numerals. But, the modifier would add that the numeral is either the lowest or highest the speaker is able to say, which in case of (29a) and (30b) would be redundant, but for (29b) and (30b) would be contradictory. If an account along these lines turns out to be valid, the argument for intermediate implicatures based on (22) remains true as stated in (Sauerland 2012). Otherwise, it may need to be modified depending on what is the best account of modified numerals.

For now, the best strategy to test for intermediate implicatures is to focus on bare numerals as in example (31). The example uses Hurford's constraint to argue that the intermediate implicature isn't a global one.

(31) Either you are allowed to read three books tonight or you are allowed to read four.

Consider furthermore example (32) where a non-monotonic quantifier is used as the higher operator to test for the intermediate implicature. The presence of the intermediate implicature can be detected in the following scenario: one student still requires two or more A grades, at least one other student needs at least three A grades, and finally some students already have enough A grades. The acceptability of (32) in this scenario must be due to interpretation arising from the intermediate implicature.

(32) Exactly one student must get two A grades.

The representation that would derive this interpretation is shown in (33).

(33) exactly one student λ_x **exh** $\Box$ [x have *two* A grades]

The argument for intermediate implicatures from (32) depends on the assumption that (33) is the only representation available for (32) that derives the intermediate implicature interpretation. If this is the case, then the argument for intermediate implicatures is complete.

The intermediate implicature account of these data, however, is not the only possible one. In two recent papers, Kennedy (2013b,a) suggests an alternative analysis that derives the same readings by assigning a scopal semantics to the numerals themselves. Specifically, Kennedy's account of (26) is based on the structure in (34). To derive this the numeral *two* could be interpreted as the cardinal degree quantifier $\lambda P \in D_{\langle d,t\rangle} .\ \max D = 2$, or as Kennedy actually assumes the insertion of the maximum operator is due to independent considerations.

(34) 2 = **max** λn $\Box$ [you have n-many A grades]

The interpretation predicted by Kennedy's degree maximization analysis of numerals is in general equivalent to that predicted by insertion of **exh** and association of *exh* with the numeral. Therefore, if Kennedy's analysis is correct, it would provide an independent account of the readings of (31) and (32) we observed above. Therefore we need to consider further implications of the two accounts to determine whether both are independently required, and could apply in examples like (31) and (32). From a semantic perspective, the difference between the two accounts is rather small despite the significant structural differences between (26b) and (34): In both structures a maximizing operator (**exh** or **max**) associates with the numeral argument position for the cardinality of A grades. This association is mediated in (26b) by alternative semantics, while variable binding does the same job in (34). Therefore (26b) and (34) end up with the same interpretation despite the structural differences.

The two major differences in prediction between the two accounts concern, as far as I can see, syntactic islands and the generalizability to other scalar and degree terms.[10] A third issue may be the question whether both **exh** and **max** are both independently motivated given the overlap between the two in (26b) and (34) and some other cases discussed below. I suspect that the more general **exh** could replace **max** in all cases, but at this point am not ready to argue this point in detail. The **max** operator is widely assumed in the semantics of comparatives (Beck 2012), so replacing it across the board with **exh** may cause unanticipated problems.

Now consider first the generalizability of the two accounts to other degree and scalar terms. In this domain, we need to compare to what extent facts like (26) actually generalize and to what extent such generalization is predicted by the two accounts we are comparing. I seek to establish below both other degree terms as well as other scalar terms interact with quantificational modals in a similar way to numerals. As I do that, I consider the possibility of applying either Kennedy's degree maximization based account or the implicature based account to the other case, and argue that it is not clear how the degree maximization based account would extend to other scalar terms. Hence, I conclude that the implicature based account has an advantage.

Consider first data with degree terms. We observe in (35) an analogous interaction between modals and scalar adjectives as the one in (26) above. (35a) would be understood as specifying a minimum height, while (35b) suggests that three meters is the maximum permitted height.

(35) a. The Christmas tree must be three meters tall.
b. The Christmas tree can be three meters tall.

However, these facts just like those with numerals above can be captured either by an implicature based analysis or a maximization based one. Representation (36a) indicates an implicature based analysis, and representation (36b) an maximization based one.

(36) a. **exh** $\Box$ [the Christmas tree be *three meters* tall]
b. 3 meters = max λd $\Box$ [the Christmas tree be d tall]

As far as I can see, it remains to be seen whether any of these two analysis is preferable for degree arguments of scalar adjectives.

[10] Kennedy (2013a) discusses an implicature based account of bare numerals, but assumes the pragmatic account throughout. His criticisms mostly don't apply to the grammatical account. I discuss some of his arguments in the following.

Now consider other scalar terms. In this case too, the pattern observed in (26) above generalizes. Consider the data in (37) with *some* and (38) with *or*.

(37) a. Joe must read some of the Harry Potter books.
b. Joe can read some of the Harry Potter books.

(38) a. Joe must go through London or New York on his trip.
b. Joe can go through London or New York on his trip.

Sentence (37a) is naturally understood as a requirement about the minimum requirement, but not a prohibition for Joe to read all the Harry Potter books. (37b), however, is naturally continued by *but he's not allowed to read all the Harry Potter books*. Similarly, (38a) may state a requirement to through at least one and possibly both of London and New York, while (38b) would express a prohibition to go through both London and New York. As with (26) above, the data with existential modals are difficult to interpret because of the entailment relation from the global to the local implicature reading in (37b) and (38b).[11] Therefore, I focus again on the data with universal modals. The implicature based analysis predicts the readings of (37a) and (38a) on the basis of the representations in (39) and (40) respectively.

(39) a. □ **exh** (Joe reads *some* Harry Potter books)
b. **exh** □ (Joe reads *some* Harry Potter books)

(40) a. □ **exh** (Joe goes through *London or New York*)
b. **exh** □ (Joe goes through *London or New York*)

While (39a) and (40a) predict a possibly available strong reading where Joe is required to read some and not all Harry Potter books and to go through London or New York and

[11] Depending on the account of free choice inferences, the entailment relation may actually not hold. Assume the account of free choice inferences of Fox (2007). The account is based on the representation (i), where the two occurrences of **exh** interact so that "$\mathbf{exh}_A$ ◊ (Joe goes through *London*)" is an element of A', the alternatives excluded by the higher occurrence of **exh**. Since this excluded alternative would entail that Joe cannot go through New York, (38b) actually entails that there must be possibility for Joe to go through New York.

(i) $\mathbf{exh}_{A'}$ $\mathbf{exh}_A$ ◊ (Joe goes through *London or New York*)

As Fox discusses, his account wouldn't predict the free choice inference for representation (ii), where the lower *exh* has local scope below ◊.

(ii) $\mathbf{exh}_{A'}$ ◊ $\mathbf{exh}_A$ (Joe goes through *London or New York*)

Therefore, Fox's account would provide independent evidence for global implicatures also with existential modals. But, Fox's has been criticized on the basis of differences between free choice inferences and (other) scalar implicatures by Chemla (2009) and others.

not both, (39b) and (40b) represent the pragmatically more salient readings where only a minimum requirement is present.[12]

The examples above only demonstrate global implicatures, but at this point, we know that then intermediate implicatures are easy to demonstrate. Spector (2013a) points out that an intermediate implicatures is available in (41), a case of a universal modal above the scalar term *some*.[13]

(41) Whenever the professor demanded that we solve *some* of the difficult problems, I managed to do what she asked, but not when she asked us to solve all of the difficult problems. (Spector 2013a, p. 290).

Example (42) shows that with disjunction too, such an intermediate implicature above a universal modal is available. The relevant scenario here is one, where the single patient who doesn't need to take both drugs daily is required to take at least drug A or drug B, but also allowed to take both drugs daily.

(42) Exactly one patient had to take drug A or drug B daily, while most had to take both.

As we see, the available readings in cases with modals and scalar terms are straightforwardly predicted by the implicature analysis. It is also possible to extend the maximization analysis to these data, but it seems to require a generalization of the **max** operator beyond degrees. (43a) shows a structure that can receive the truth conditions of (41b), and (43b) one for (42b).

(43) a. some = **max** λ_q $\Box$ (Joe reads $q^{\langle et,t\rangle}$ Harry Potter books)
b. or = **max** λ_j $\Box$ (Joe goes through London $j^{\langle t,tt\rangle}$ Joe goes through New York)

A lexical entry of the **max** operator that can apply to any predicate type αst that would work for (43) is given in (44).

(44) **max**($P^{\alpha st}$)(w) = ω if ω is the unique lexical item of type αt such that $P(\omega)(w) = 1$ and for any other lexical item ω' of type αt, $P(\omega')(w) = 0$ or $P(\omega) \rightarrow P(\omega')$. Furthermore, if there's no such unique ω, **max** is undefined.

To maintain an account like Kennedy's that is based on movement and maximization seems to me to necessitate the move to (43) and (44). The question is whether such general

[12] Marie-Christine Meyer (personal communication) notes that the preference for the weaker readings in (39) and (40) is suprising from the perspective of the work Chierchia et al. (2012) where a preference from strong readings plays a role.

[13] Spector's argument assumes that the professor only states a minimum requirement. Then the first *whenever*-clause must have the representation (i) to include those times when the professor required some, but exclude those times when the professor required all difficult problems.

(i) whenever **exh** $\Box$ we solve *some* difficult problems movement of scalar items is without problems—at present though it seems possible. Two arguments of Kennedy's are relevant to this point: one, he claims to have evidence that other scalar terms behave differently from numerals in relevant respects, and two, he claims to have independent evidence for movement of numerals.

Consider first Kennedy's claim that other scalar terms differ from other numerals in relevant respects. (37) and (38) showed that other scalar items behave alike to numerals (specifically (26)). Such parallelism, as I mentioned, are predicted by the implicature based account, and therefore these data might provide a reason to prefer this account over the degree maximization account. But if there are also examples where other scalar items differ from numerals when the implicature account predicts them to be parallel, such examples would argue against the implicature based account. Specifically, Kennedy's data concern the observation already mentioned above that local scalar implicatures are absent in downward entailing environments unless the scalar term is focussed (see (10) above). Kennedy (2013b) observes a difference between the numeral *two* and the scalar term *some* in downward entailing environments: Specifically, he points out the following scenario: some individuals are eligible for no tax exemptions, others eligible for two, and yet others for all four, and everybody claims the maximum number allowed but no more. In this scenario, (45a) is judged true, but (45b) isn't.

(45) (Kennedy 2013b)

a. No individual who was allowed to claim two exemptions claimed four.
b. #No individual who was allowed to claim some exemptions claimed four.

Kennedy's example (45b), however, contains the positive polarity item *some*, so the comparion he uses might not be revealing. Specifically, *some* might have to take scope above *no*. Such a reading would be difficult to evaluate in Kennedy's scenario because the identity of the tax exemptions would matter. Assume though an amended scenario: The tax exemptions are numbered 1 through 4, and everybody who is eligible to claim exemption n for $n > 1$ is also eligible to claim exemption $n-1$. So, in this scenario the individuals eligible for two exemptions must all be eligible for exemptions 1 and 2. However, already the literal reading with wide scope of *some* is false in this scenario: There are individuals eligible to claim exemptions 1 and 2 (distributively or collectively) that claimed all four. So, the judgement Kennedy reports for (45b) is also predicted by the implicature based theory.[14] Hence, I conclude that the data in (45) don't provide an argument for a relevant difference between numerals and other scalar terms at this point. Possibly looking at focus might help though. Only the implicature based analysis seems to predict that (45a) ought to require focus on the scalar term *two* as in other cases of scalar terms embedded in downward entailing environments. As Spector (2013b) already mentions, this area may require formal experiments to properly evaluate the two accounts further.

[14] It might be marginally possible though to apply **exh** in the scope of *no* in (45b). In the amended scenario, this would result in a true reading equivalent to *No individual who was allowed to claim only exemptions 1 and 2 claimed four*.

Now consider the arguments Kennedy cites as independent support for movement of numerals. Specifically, he reports that scoping of numerals is independently required by the semantics of *average* developed by Kennedy and Stanley (2009). As we saw above, the degree maximization approach seems to require similar movement of other scalar terms. So, it is interesting to investigate whether the arguments for movement Kennedy cites carry over to other scalar items. In the following, I aim to show that this seems to be the case, however, at the same time I have some reservations concerning the arguments of Kennedy and Stanley (2009).

The independent arguments of Kennedy and Stanley (2009) for movement of bare numerals rest on a novel analysis of sentences such as (46a). They propose that *average* is a polyadic quantifier as shown in the structure (46b), while the definite article is vacuous. Spefically, the lexical entry for *th'average* required is $\lambda P \lambda Q \lambda d$ .mean($\{max_n(Q)(n)(x) \mid P(x)\}) = d$.

(46) a. The average American has 2.3 children.
b. th'average(American)(λn λx . x has n children)(2.3)

Now consider the examples in (47) with *or* and *some* respectively. A relevant scenario for (47a) is the following: All movies that where Tom appears Jerry appears too. 50% of Americans have watched at least one Tom and Jerry movie, while the other 50% haven't. And for (47b), the test scenario is: Americans either love basketball and know the names of all the NBA teams or they hate it and don't know any of the NBA teams.

(47) a. The average American has seen Tom or Jerry.
b. The average American knows the names of some of the NBA teams.

In my judgement of German counterparts,[15] both sentences are acceptable though (47a) feels a little bit like a joke. Still I feel compelled to accept the statement as true in the scenario given. The joke nature is diminished when the disjunction occurs in a coordination as in (48).

(48) The average American has 2.3 children, has seen Tom or Jerry, and lives in Belle Fourche, South Dakota.

It seems therefore that the arguments of Kennedy and Stanley (2009) for numeral movement may also indicate movement of *some* and *or* of the type made use of in (43). However, I believe it remains to be seen whether any of these movements is actually warranted, or whether an alternative to the analysis of Kennedy and Stanley (2009) not invoking this movements is possible. At this point, I cannot present a full-fledged alternative analysis to

[15]Namely, I considered the following German sentences:

(i) Der Durchschnittsamerikaner hat Tom oder Jerry gesehen.

(ii) Der Durchschnittsamerikaner kennt die Namen von ein paar der NBA Teams.

that of Kennedy and Stanley (2009). Nevertheless, I would like to point out one potential problems for the analysis of Kennedy and Stanley (2009):[16] This concerns island effects. The analysis of Kennedy and Stanley (2009) seems to predict that the numeral or degree term *average* associates with should not be separated from *average* by a syntactic island because it needs to move into an argument position of *average*. As far as I can see, this prediction does not obtain: the examples in (49) show the phrase 2.3 children embedded within an coordinate structure in (49a),[17] a conditional clause in (49b), and a relative clause in (49c). At this point, the judgments I report are my own for similar German examples.[18]

(49) a. The average American has 2.3 children and a dog.
 b. The average American is born into a family that has 2.3 children.
 c. The average American is most satisfied if the president has 2.3 children.

An intermediate summary: Numerals and other scalar expressions (i.e. *some* and *or*) interact with modals in very similar fashion. This is predicted by the implicature based analysis, but not by the degree maximization analysis. However, it is possible to change the degree maximization analysis to a more general scalar maximization analysis as shown in (43) where all scalar expressions can undergo movement. This general maximization analysis would predict all the parallels between numerals and other scalar expressions we observed above just like the implicature analysis does.

At this point, the one significant difference in prediction between the two analyses that remains concerns syntactic islands: Syntactic movement of numerals only plays a role in Kennedy's degree maximization analysis, but not in the scalar implicature analysis. Therefore, syntactic islands are predicted to render certain readings unavailable if the degree maximization analysis is correct, while the scalar implicature analysis would predict the same readings to be available. The one relevant case that Kennedy (2013a) discusses are epistemic modals, however, he only considers examples with modified numerals like (50).

(50) Chicago might have at least 200 distinct neighborhoods. (Kennedy 2013a, p. 9)

As I mentioned above, the analysis of modified numerals is contested. At least one analysis of modified numerals, however, would predict them to be island sensitive on independent grounds. Namely, Cohen and Krifka (2011) propose to analyze the superlative modifiers

[16] In addition, the assumption that the definite *the* is vacuous has little appeal to me. Kennedy and Stanley (2009) adopt this assumption from Carlson and Pelletier (2002).

[17] (Kennedy and Stanley 2009, p. 636–638) suggest an analysis of examples similar to (49a) where the first conjunct contains an additional silent *on average*.

[18] Specifically, the German data are:

(i) Der Durchschnittsamerikaner hat 2,3 Kinder und einen Hund.

(ii) Der Durchschnittsamerikaner ist ein einer Familie aufgewachsen, die 2,3 Kinder hatte.

(iii) Der Durchschnittsamerikaner ist am zufriedensten, wenn der Präsident 2,3 Kinder hat.

as meta speech-acts. Since these require scope at the speech act level independently of the numeral they attach to, the cause of the effects Kennedy observes in (50) may be the superlative modifier rather than the numeral.

Therefore, we consider bare numerals in the following. In my judgment, bare numerals interact with epistemic modals in much the same way as with root modals. For example, (51a) suggests that I have evidence that rules out Marie from having fewer than three children, but is compatible with her having more than three. But, (51b) could be uttered in a scenario where three is maximum of children I consider possible, e.g. if I last saw her childless 12 months ago and she couldn't have more than triplets in one pregnancy.[19]

(51) a. Marie must have three children by now.
b. Marie might have three children by now.

Since epistemic modals generally block scope movement of quantifiers, the wide scope interpretations in (51) are not expected by Kennedy's movement based degree maximization analysis. They are expected, however, by the implicature based analysis of the numeral-modal interaction.

Further evidence corroborates that wide scope of exhaustification/maximization is not subject to syntactic islands. Specifically, Spector (2013b) considers another type of syntactic island, namely the complex noun phrase island in (52) to argue for the necessity of intermediate implicatures.

(52) Whenever the professor made the request that we solve three problems, I managed to do what she asked, but not when she asked us to solve more than three problems. (Spector 2013b, p. 293)

Another type of island that is interesting to consider are DP-quantifiers. Kennedy (1997) argues that DP-quantifiers are islands for degree quantification. However, it seems that DP-quantifiers interact with numerals in a similar way as modals: In particular, (53a) is acceptable in a scenario where some students wrote more than two pages, as long as none wrote fewer.

(53) a. Every student wrote two pages.
b. Some student wrote twenty pages.

The facts in (51) through (53) all argue that Kennedy's movement of numerals cannot be the only mechanism that derives structure where a numeral is related to an exhaustivizing/maximalizing operator that takes scope above the surface position of the numeral. On the implicature-based approach, **exh** can be generated in various positions above the numeral and is associated with it not by syntactic movement, but by alternative semantics.

[19] As I mentioned above, the local interpretation is entailed by the global one with existential modals, and therefore the acceptability test may be misleading in this scenario. I mainly mention the existential case here as a contrast with the universal modal.

This analysis predicts the data in (51) through (53) straightforwardly. It also predicts, of course, the cases where syntactic movement of the numeral or scalar term doesn't cross an island. For this reason, I conclude that the movement part of the analysis of numerals by Kennedy (2013a,b) is unnecessary. Instead, it is sufficient to generally allow insertion of **exh** and association of it with numerals as Spector (2013b) already suggests. Importantly, such an analysis requires implicature computation in intermediate positions. Specifically, I argued that the examples (22), (31), (32), (41), (42), and (52) provide evidence for intermediate implicatures. This need for intermediate implicatures in turn argues for the grammatical analysis of implicatures over the pragmatic one.

4 Conclusion

This paper sought to answer a question I raised in an earlier paper (Sauerland 2012): Are there intermediate implicatures? I define intermediate implicatures as implicatures that take scope above one quantificational operator but below a second one. Because intermediate implicatures can be explained neither by sentence-level pragmatic operations nor by word-level lexical operations, intermediate implicatures if they exist provide strong evidence in favor of the grammatical analysis of implicatures (e.g. Chierchia et al. 2012).

Testing for the presence of intermediate implicatures, I argued, is no easier than testing for local vs. global implicatures. But by building on the results of that discussion, we focused on two cases of higher quantifier: non-monotonic quantifiers and Hurford disjunctions. Furthermore, I focussed on two cases of lower quantifier and scalar items: the maximal scalar items *all* and *and* embedded below downward entailing operators in section 2 and numerals and other scalar items below universal modals in section 3. In both cases, the evidence supported the existence of intermediate implicatures. Specifically, I discussed in section 3 a possible alternative analysis based on deriving intermediate scope by movement of the scalar term (Kennedy 2013a,b), but showed, that such an analysis cannot explain all the relevant data. Therefore, I conclude that intermediate implicatures exist. This constitutes an argument in favor of the grammatical analysis of scalar implicatures.

Further types of structures exist where the presence of intermediate implicatures can be tested beyond those I explored in this paper. One case I am aware of is due to Meyer (2013): Meyer argues that all sentences contain a silent epistemic necessity modal K. If her proposal is correct, it predicts an additional case of intermediate implicatures. Specifically, recall the distinction between *primary* and *secondary* implicatures (Sauerland 2004b): for an alternative A, the primary implicature is $\neg KA$ ('the speaker isn't certain that A holds'), while the secondary one is $K\neg A$ ('the speaker is certain that A doesn't hold'). As mentioned in section 2, the (Sauerland 2004b) version of the pragmatic approach derives first primary, and then from these and a competence assumption secondary implicatures. On Meyer's proposal, however, the two types of implicatures can be derived from different relative scopes of **exh** and K. Specifically, K taking scope over **exh** predicts secondary implicatures. Therefore, Meyer's proposal has the following consequence: Consider an example with one overt quantifier Q taking scope over a scalar item (e.g. (4) above). We know that in such examples implicature computation can takes scope over the quantifier Q. If furthermore the resulting implicature has the epistemic strength of secondary implicatures, this would provide further evidence for the existence of intermediate implicatures because then **exh** needs to take scope above Q but below Meyer's K.

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