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Licensing strong NPIs

Jon R. Gajewski

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Abstract This paper proposes that both weak and strong NPIs in English are sensitive to the downward entailingness of their licensers. It is also proposed, however, that these two types of NPIs pay attention to different aspects of the meaning of their environment. As observed by von Fintel and Chierchia, weak NPIs do not attend to the scalar implicatures of presuppositions of their licensers. Strong NPIs see both the truth-conditional and non-truth-conditional (scalar implications, presuppositions) meaning of their licensers. This theory accounts for the puzzling inability, noted by Rullmann and Gajewski, of Strawson anti-additive operators to license strong NPIs, as well as for the effects of Zwarts's hierarchy of negative strength. Additional issues concerning comparative quantifiers, *few*, and proportional quantifiers are addressed.

Keywords Negative polarity items · Negation · Negative strength · Downward entailing · Anti-additive · Scalar implicature · Presupposition

1 Introduction

The role that non-truth-conditional meaning plays in the licensing of negative polarity items (NPIs) has been a topic of great recent interest. Most of this literature has played out as an elaboration of the influential hypotheses of Ladusaw (1979) and Kadmon and Landman (1993). Ladusaw identifies the class of licensers for NPIs like *any* and *ever* as the downward entailing (DE) functions. Kadmon and Landman propose to explain *any*'s sensitivity to these DE functions through the idea that *any* has a wider domain than other corresponding indefinites, but must make a stronger

J. R. Gajewski (✉)
Department of Linguistics, University of Connecticut, Storrs, CT 06269-1145, USA
e-mail: jon.gajewski@uconn.edu

statement than those other indefinites. These theories leave open several issues concerning the integration of presuppositions and implicatures. The question of how the presuppositions of an operator figure into its NPI licensing abilities was addressed by von Fintel (1999). Following suggestions of Ladusaw (1979) and Strawson (1952), von Fintel argues that the presuppositions of an operator must, in a sense, be factored out of the assessment of its licensing abilities. Chierchia (2004) addresses the effects of certain scalar implicatures on licensing. Specifically, Chierchia claims that intervention effects of the kind observed by Linebarger (1987) could be explained as the interference of scalar implicatures, given *any*'s desire to widen and strengthen. Following Chierchia, Homer (2008, 2009) argues that presuppositions create intervention effects much like scalar implicatures.

Most of this literature about the interaction of non-truth-conditional meaning and NPI licensing has been concerned with the licensing of weak NPIs like *any* and *ever*. It is well known, however, that there are other so-called strong NPIs, like *either* and *in years*, that are licensed by a proper subset of the operators that license *any* and *ever*. The most influential hypothesis concerning strong NPIs, due to Zwarts (1998), is that they require licensers that are anti-additive, which is downward entailingness plus an additional formal property. It is natural to ask whether non-truth-conditional meaning plays the same role in licensing strong NPIs that it plays in licensing weak NPIs. Surprisingly the answer appears to be No. Gajewski (2005, 2007), who follows Rullmann (2003), and Homer (2008) observe that we cannot ignore the presuppositions of the licensers of strong NPIs. Gajewski (2005) shows that, when their presuppositions are factored out by Strawson Entailment, there are many functions such as *only* that come out to be anti-additive yet do not license strong NPIs. Gajewski and Homer conclude that the presuppositions of potential licensers must be taken into account when checking the licensing of strong NPIs.

The main goal of this paper is to address one final piece of the puzzle. Chierchia (2004) observes that only certain implicatures interfere with the licensing of *any*. In particular, implicatures triggered by a non-weak scalar item in the scope of a licenser, called 'indirect' implicatures by Chierchia, interfere with licensing; but 'direct' implicatures triggered by the licenser itself do *not* interfere with licensing. So, just as von Fintel (1999) argues that the presuppositions of licensers have no effect on licensing (weak) NPIs, Chierchia argues that scalar implicatures triggered by a licenser have no effect on licensing. However, as we have just seen, Gajewski and Homer argue that the presuppositions of licensers do interfere with the licensing of strong NPIs. So, we must ask whether the same is true of scalar implicatures. I argue that it is. Specifically, I argue that the scalar implicatures of licensers do interfere with the licensing of strong NPIs. I argue, furthermore, that this brings about a dramatic simplification in the statement of the licensing conditions of strong NPIs. In particular, I argue that there is no need to refer to any formal property other than downward entailingness in describing the licensing environments for strong NPIs. The difference between weak and strong NPIs reduces to which aspects of the meaning of an NPI's environment are relevant to licensing. Specifically, strong NPIs are sensitive to the implicatures and presuppositions triggered by a licenser, while weak NPIs are not.

The structure of the paper is as follows. In Sect. 2, I spell out my background assumptions about NPI licensing. In Sect. 3, I introduce the problems that presuppositions and implicatures pose for standard approaches to NPI licensing. In Sect. 4, I lay out my proposal for the central problem concerning the role of implicatures in the licensing of strong NPIs. The proposal is fully integrated with the findings of von Fintel, Chierchia, Gajewski, and Homer concerning the role that non-truth-conditional meaning plays in the licensing of weak and strong NPIs. In Sect. 5, I briefly address the alternative proposal of Giannakidou (2006) concerning the distribution of strong NPIs. Section 6 concludes.

2 Background assumptions about NPI licensing

2.1 Downward entailment

Like the majority of the literature I am building on, I take Ladusaw's (1979) *Downward Entailing Hypothesis* (DEH) as the starting point for my analysis. Ladusaw offers a semantic characterization of the expressions that license negative polarity items like *any* and *ever*. Previously, there had been no convincing characterization of those expressions that do ((1a–d)) and those that do not ((1e, f)) license negative polarity items.

(1) a. Bill didn't ever say anything.
 b. No student ever said anything.
 c. Few students ever said anything.
 d. At most 5 students ever said anything.
 e. *Between 5 and 10 students ever said anything.
 f. *Some/*all/*most students ever said anything.

According to the DEH, an NPI is licensed if it occurs in the scope of an operator that is *downward entailing* (DE), as stated in von Fintel (1999), based on Ladusaw's (1979) ideas:

(2) A NPI is only grammatical if it is in the scope of an α such that $[\![\alpha]\!]$ is downward entailing. (von Fintel 1999, p. 100)

(3) (Weak) NPIs: *any, ever, et all…*

(4) A function F of type $\langle\sigma,\tau\rangle$ is downward entailing iff for all x,y of type σ such that $x \Rightarrow y$: $F(y) \Rightarrow F(x)$. (von Fintel 1999, p. 100)
 ['$\Rightarrow$' stands for cross-categorial entailment]

It is a simple matter to show, given these definitions, that *not*, *no students*, *few students*, and *at most 5 students* denote DE functions and that *between 5 and 10 students* and *some students* do not. I leave this to the reader. Informally, one can convince oneself of DE-ness by observing intuitive entailments from sets to subsets. For example, (5) is valid but (6) is not.

(5) No student smokes.
$\{x: x \text{ smokes Camels}\} \subseteq \{y: y \text{ smokes}\}$
$\therefore$ No student smokes Camels.

(6) Between 5 and 10 students smoke.
$\{x: x \text{ smokes Camels}\} \subseteq \{y: y \text{ smokes}\}$
$\therefore$ Between 5 and 10 students smoke Camels.

One can see that the latter argument is invalid by considering the possibility that five students smoke, but only two smoke Camels. *No student* denotes a DE function, whereas *between 5 and 10 students* denotes a non-monotonic function.[1]

2.2 Anti-additivity

As mentioned in the Sect. 1, NPIs in English divide into (at least) two classes. The weak NPIs, such as *any* and *ever*, enjoy a wider distribution than the so-called strong NPIs. The strong NPIs that we will focus on in this paper are *in weeks*, additive *either*, and punctual *until*.[2] For arguments in favor of the NPI status of these items see Hoeksema (2006), Rullmann (2003), and de Swart (1996)/Giannakidou (2002), respectively.[3] To get a flavor of the difference in the distribution of weak and strong NPIs, observe the acceptability of punctual *until* in the following environments.

(7) a. Bill didn't leave until his birthday.
b. No student left until his birthday.
c. ??Few students left until their birthdays.
d. *At most 5 students left until their birthdays.
e. *Between 5 and 10 students left until their birthdays.
f. *Some/*most/*all students left until their birthdays.

While *any* is acceptable in the scope of sentential negation, negated existentials (*no student*), *few NP,* and *at most 5 NP*, the strong NPI *until* is only fully acceptable in the scope of sentential negation and negated existentials such as (7a, b). There is disagreement about the acceptability of strong NPIs in the scope of *few NP*, as in (7c). Zwarts (1998) excluded them; Hoeksema (2006) and Rullmann (2003) argue

[1] The alert reader will remember that while *between 5 and 10 students* does not license NPIs, *exactly* 5 *students*, also non-monotonic, can in some circumstances. I will have nothing intelligent to say about this well-known problem case.

[2] I do not include minimizers in the class of strong NPIs. I believe minimizers have a broader distribution and receive a good analysis in terms of covert *even*; cf. Heim (1984), Lahiri (1998), Guerzoni (2004).

[3] These authors argue against analyzing these as strong NPIs in Zwarts's sense. We will address their worries below.

that *in weeks* and *either*, respectively, are acceptable in the scope of *few*. We return to this disagreement later.

Strong NPIs, then, have a more limited distribution than weak NPIs. The most influential account of the distribution of strong NPIs comes from Zwarts (1998); see also van der Wouden (1997). Zwarts suggests that strong NPIs require a logical property stronger than DE-ness in their licensers. Specifically, Zwarts argues that strong NPIs require *anti-additive* licensers. The logical property of anti-additivity (AA) is defined in (10), a paraphrase of Zwarts's (1998, p. 222) formulation. Note that, as is well known, being AA implies being DE, since being DE is equivalent to the left-to-right direction of (10); see the proof in (11).

(8) A strong NPI α is licensed only if α occurs in the scope of an anti-additive operator.

(9) Strong NPIs: additive *either*, *in weeks*, punctual *until*

(10) A function F of type $\langle\sigma,\tau\rangle$ is anti-additive iff for all x,y of type σ:
$F(x \vee y) \Leftrightarrow F(x) \wedge F(y)$

(11) F is DE *iff* for any A, B: $F(A \vee B) \Rightarrow F(A) \wedge F(B)$

Left-to-right:	(i)	Suppose F is DE.
	(ii)	Note that $A \Rightarrow A \vee B$ and $B \Rightarrow A \vee B$.
	(iii)	So, $F(A \vee B) \Rightarrow F(A)$ and $F(A \vee B) \Rightarrow F(B)$, by (i)–(iii).
	(iv)	It follows that $F(A \vee B) \Rightarrow F(A) \vee F(B)$.
Right-to-left:	(i)	Assume for any A, B: $F(A \vee B) \Rightarrow F(A) \wedge F(B)$.
	(ii)	Consider arbitrary C, D such that $D \Rightarrow C$.
	(iii)	$F(C \vee D) \Rightarrow F(C) \wedge F(D)$, by (i) and (ii) .
	(iv)	Note that $C = C \vee D$, given (ii).
	(v)	It follows from (iii) that $F(C \vee D) \Rightarrow F(D)$.
	(iv)	Thus, $F(C) \Rightarrow F(D)$, given (iv).

So, anti-additivity picks out a proper subset of the licensers picked out by downward entailingness. The intuitive test for anti-additivity is the equivalence of wide scope conjunction with narrow scope disjunction:

(12) No student smokes or drinks $\Leftrightarrow$ No student smokes and no student drinks

(13) Few students smoke or drink $\Leftrightarrow$ Few students smoke and few students drink

No student is AA because the equivalence in (12) is valid. *Few students* is not AA because the equivalence in (13) intuitively does not hold: it could be that few students drink and few students smoke, but when you put the student-smokers and student-drinkers together and count them you get more than few. Quantifiers such as *not every NP* and *at most 5 NP* are also DE, but not AA. I leave confirmation of this to the reader.

AA versus DE seems to correctly describe the differences in distribution between weak NPIs and strong NPIs. The former require a DE licenser, the latter an AA licenser. *No doctor* is AA; *at most 5 doctors* is DE but not AA.

(14) a. No doctor has seen anyone.
b. At most 5 doctors have seen anyone.

(15) a. No doctor has seen Mary in weeks.
b. *At most 5 doctors have seen Mary in weeks.

As mentioned, the status of *few* in this classification of licensers is controversial. While the strong NPIs listed in (9) seem to follow the Zwarts classification quite well, it has been pointed out that they sometimes tolerate *few* as a licenser.

(16) He was one of the few dogs I'd met in years that I really liked.
(Sue Grafton, *A is for Alibi*, reported in Hoeksema 2006)

(17) Few Americans have ever been to Spain. Few Canadians have either.
(Rullman 2003)

(18) He invited few people$_i$ until he knew she liked them$_i$.
(de Swart 1996)

Other expressions that license strong NPIs but fail the test for AA are *hardly any/ever* and *little*. We return to this challenge for Zwarts below in Sect. 4.3.

With this background in place, we move on in the next section to problems for this classical DE + AA picture. These all derive from the need to clarify the role of scalar implicatures and presuppositions in NPI licensing.

3 Non-truth-conditional cracks in the Ladusaw/Zwarts picture

In this section, we go through the problems posed by non-truth-conditional meaning for the theory sketched in Sect. 2. We begin with von Fintel and the presuppositions of licensers. Next we discuss Chierchia's and Homer's work on the role of implicature and presupposition in intervention. Finally, we move on to Gajewski's and Homer's discussion of the presuppositions of the licensers of strong NPIs.

3.1 Weak NPIs are licensed by apparently non-DE operators

As successful as the DE hypothesis is, it has many well-known, long-standing problems. Von Fintel (1999) takes a significant step forward in resolving some of these. One kind of counterexample to the DEH are sentences in which an NPI is licensed in an environment that is not intuitively DE.

(19) a. Only Bill ate anything.
b. Bill is sorry that he said anything.
c. If Bill ate anything, then it was a hoagie.

(20) a. Only Bill ate a vegetable.
#Therefore, only Bill ate kale.
b. If Bill ate something, it was a hoagie.
#Therefore, if Bill ate something healthy, it was a Hoagie.
c. Bill is sorry he gave Mary a present.
#Therefore, Bill is sorry he gave Mary a present she loved.

In (19) we see that *any* is licensed by *only*, *sorry,* and in the antecedent of bare conditionals. In (20), however, we see that these environments do not intuitively license inferences from sets to subsets. Given the DEH, this is troubling since we expect DE operators to license such inferences.

Von Fintel (1999) argues that in (19a–d), it is a presupposition of the licenser that interferes with the intuitive DE-ness. He neutralizes the interference of presuppositions by redefining the notion of DE-ness relevant to NPI-licensing.[4] Take the example of *only*. Its truth conditions are DE with respect to the predicate P:

(21) [Only a] P is defined only if $\mathbf{a} \in$ P.
When defined, [Only **a**] P is True iff *there is no* $x \neq \mathbf{a}$ *such that* $x \in$ P.

This DE-ness is masked, however, by *only*'s presupposition. Whereas the truth conditions say that no one who is not **a** has property P, the presupposition states that **a** has property P. If no one who is not **a** is a member of P, then no one who is not **a** is a member of any subset of P. However, **a**'s being a member of P does not imply that **a** is a member of every subset of P. Von Fintel redefines DE-ness as below, stipulating that to test DE-ness we must first take for granted that the presupposition of the conclusion of the set-to-subset argument is satisfied. Notice that Strawson DE-ness is a weaker notion than DE-ness.

(22) *Strawson Downward Entailingness*
A function f of type $\langle\sigma,\tau\rangle$ is Strawson-DE
iff for all x, y of type σ such that x $\Rightarrow$ y and f(x) is defined: f(y) $\Rightarrow$ f(x).
(von Fintel 1999, p. 104)

Von Fintel chose to define Strawson-DE directly rather than defining Strawson Entailment and then defining directional entailment in terms of Strawson Entailment. There seems to be no reason not to first define Strawson Entailment, so let's do so now (following Schwarz 2006; Sharvit and Herdan 2006; among others). The definition in (23) is recursive. Note that the recusion begins at the level of truth values, where the relation described is equivalent to a material conditional.

[4] See also Horn (2002, to appear) for another attempt to prevent presuppositions from disrupting licensing.

(23) *Cross-categorial Strawson Entailment* ($\Rightarrow_S$)
a. For p, q of type t: p $\Rightarrow_S$ q iff p = False or q = True.
b. For f, g of type $\langle\sigma,\tau\rangle$: f $\Rightarrow_S$ g iff for all x of type σ such that g(x) is defined: f(x) $\Rightarrow_S$ g(x).

This definition will allow us to use Strawson Entailment to define other notions relevant to NPI-licensing. This will become important below.

Given these definitions, we find now that *only* does come out Strawson-DE. To see this, notice that the argument in (24) is intuitively valid. I leave it to the reader to work out the formal Strawson DE-ness of the entry in (21).

(24) Only Bill ate a vegetable.
Bill ate kale.
{x: x is kale} $\subseteq$ {y: y is a vegetable}
Therefore, only Bill ate kale.

Von Fintel argues at great length that appropriate analysis of the other constructions exhibited in (19), paying special attention to the division between truth conditions and presuppositions, yields meanings that satisfy the definition of Strawson-DE. Von Fintel's specific proposals are discussed in Appendix 1.

In sum, von Fintel showed how factoring out presuppositions reveals the underlying DE-ness of certain NPI licensers. In the next section, we turn to the topic of intervention, or how implicatures and presuppositions triggered by operators between a licenser and an NPI can hinder licensing.

3.2 Intervention

Intervention occurs when certain expressions come between a licensing expression and an NPI and prevent licensing. Consider the following standard example.

(25) a. Bill didn't give Mary anything.
b. *Bill didn't give everyone anything.

In (25a), sentential negation *n't* licenses the NPI *anything* in the second object position. In (25b), however, *Mary* has been replaced with *everyone* and licensing is no longer possible. In such cases, it is said that *everyone* intervenes in the licensing of *anyone*.

Recent works have implicated non-truth-conditional meanings triggered by interveners as the culprit behind their intervening behavior. Chierchia (2004) argues that scalar implicatures triggered by expressions such as *everyone* interfere with licensing. Homer (2008, 2009) likewise argues that the presuppositions triggered by expressions between licensers and NPIs can disrupt licensing. Their work is reviewed in turn in Sects. 3.2.1 and 3.2.2.

3.2.1 Implicatures

Chierchia argues that intervention effects in NPI licensing can be analyzed as the interference of an implicature with the licensing of an NPI. More specifically, Chierchia argues that the class of interveners can be identified as the class of expressions that do not sit at the weak end of a Horn scale. Whenever such an item falls between a DE expression and an NPI, a quantity implicature is generated since a stronger statement could have been made by replacing the item with the weak endpoint of the scale. This implicature is added to the meaning of the minimal constituent containing the DE operator. The addition of the implicature interferes with downward entailment, and thus with *any*'s need to widen and strengthen; cf. Kadmon and Landman (1993). For example, *every NP*, which is not a weak scalar endpoint, introduces an implicature when in the scope of a DE operator. This implicature makes *every NP* an intervener for NPI-licensing. (Assume that *any* is an existential quantifier, like *some*.)

(26) The quantifier *everyone* intervenes for licensing of *anything*:
*Bill didn't give everyone anything.
NOT Bill gave EVERYone ANYthing

The reason is that a weaker member of *every NP*'s scale could have been used, yielding a globally stronger statement; cf. (27).

(27) Stronger alternative to (26):
NOT Bill gave SOMEone ANYthing

Hence, by standard scalar Gricean reasoning, this stronger alternative is taken to be false.[5]

(28) Implicature (negation of stronger alternative):
NOT NOT Bill gave SOMEone ANYthing
'Bill gave someone something.'

The 'strong meaning' for sentence (26), then, is the conjunction of its plain meaning and the negation of the stronger alternative, (28):

(29) Strong Meaning:
(NOT Bill gave EVERYone ANYthing) AND (Bill gave SOMEONE ANYthing)

Notice now that this strong meaning does not create a DE environment in the position of the NPI. For example, the set-to-subset inference from things in (29) to books in (30) is not valid.

[5] Chierchia's view, however, is not a standard Gricean one, as we will see below. Instead, he argues for the grammatical calculation of scalar implicatures.

(30) Lack of DE:
*(NOT Bill gave EVERYone ANYbook) AND (Bill gave SOMEONE ANYbook)

In this way, the presence of a non-weak scalar endpoint between an NPI and a DE operator can block licensing by destroying DE-ness.

So, Chierchia argues that implicatures can insinuate themselves into the licensing of NPIs. At first this might seem odd, since many intervention effects are irrevocable, whereas implicatures are by definition defeasible. Chierchia urges us to ignore the fact that context can override an implicature and to simply focus on the role implicatures play in the compositional interpretation of sentences. In other words, the licensing conditions of NPIs make reference to the recursive contributions of implicatures, even if those contributions are rather labile in context.

3.2.2 Presuppositions

Homer (2008, 2009) presents data similar to Chierchia's, arguing that presuppositions create intervention effects like those created by scalar implicature. While *any* is licensed in (31), the presence of the presuppositional focus particle *too* disrupts licensing in (32).

(31) Bob doesn't think John read anything interesting.

(32) A: Mary read something interesting.
B: *Bob doesn't think $[\text{John}]_F$ read anything interesting, too.

Homer attributes this to the fact that when presuppositions are taken into account, the environment in (36B) is not DE. For example, the downward inference from (33a) to (33b) does not intuitively go through.

(33) a. Bob doesn't think $[\text{John}]_F$ smokes, too.
b. Bob doesn't think $[\text{John}]_F$ smokes Marlboros, too.

Homer suggests that NPI licensing is assessed in a coordinate of meaning in which truth conditions and presuppositions are conjoined. From this perspective, we can easily see how the presuppositions of *too* interfere with licensing. While the first conjunct of (35a) entails the first conjunct of (35b), the second conjunct of (35a) does not entail the second conjunct of (35b).

(34) Conjunction of the truth conditions and presupposition of (33a): Bob doesn't think John smokes and (Bob thinks) someone other than John smokes.

(35) a. Bob doesn't think John smokes and (Bob thinks) someone other than John smokes.

b. Bob doesn't think John smokes Marlboros and (Bob thinks) someone other than John smokes Marlboros.

Homer provides many further examples supporting the generalization that presuppositions can intervene for NPI-licensing, including indicative mood in Italian, *why*-questions in French, and a variety of triggers in English.[6] Importantly, Homer also analyzes the failure of certain operators to license NPIs as 'intervention' by the presupposition of the (potential) licenser. This runs contrary to the proposal I make in Sect. 4. We will return to discussion of such cases below.

3.2.3 Conclusions

The works of Chierchia (2004) and Homer (2008, 2009) argue that both scalar implicatures and presuppositions can interfere with the licensing of NPIs. This contrasts with von Fintel's (1999) claim that the presuppositions of a function are not factored into the assessment of its licensing properties. In the next section, we examine Gajewski's (2005, 2007) and Homer's (2009) arguments that the presuppositions of functions do play a role in determining whether or not they can license strong NPIs.

3.3 Presupposition and the licensing of strong NPIs

As we have seen above, von Fintel (1999) argues that the presuppositions of functions must be factored out when assessing their NPI-licensing abilities. Specifically, von Fintel redefines the notion of entailment that is used in formalizing Ladusaw's NPI-licensing condition. This raises the question of whether something similar should be done for Zwarts's licensing condition for strong NPIs. This question is addressed in the work of Gajewski (2005, 2007) and Homer (2009).

Gajewski (2005), following an observation of Rullmann (2003, fn. 29) concerning *only*, defines anti-additivity in terms of Strawson entailment and tests whether functions that meet the condition of *Strawson anti-additivity,* as stated in (36), do in fact license strong NPIs.

(36) A function F of type $\langle \sigma, \tau \rangle$ is *Strawson anti-additive* (SAA) iff for all x, y of type σ: $F(x \vee y) \Leftrightarrow_S F(x) \wedge F(y)$.[7]

Because SAA is weaker than AA, *no NP* and other AA operators that license strong NPIs are SAA. However, there are many other operators that qualify as SAA that do

[6] This is an oversimplification of Homer's findings. Homer (2008, 2009) also observes that there are some presupposition triggers that do not cause intervention effects. For example, *again* does not disrupt licensing though it scopes over *any*:

(i) I don't think John [ate anything interesting] again.

Homer leaves the difference between triggers to future research, as will I (though see the discussion in Sect. 4.4).

[7] $P \Leftrightarrow_S Q$ if and only if $P \Rightarrow_S Q$ and $Q \Rightarrow_S P$.

not license strong NPIs (cf. Atlas 1996; Horn 1996; Nathan 1999; Gajewski 2005; Giannakidou 2006; Homer 2009). One such operator is *only NP*. Given the meaning for *only* in (21) and the condition for SAA in (36), we see from (37) and (38) that *only NP* is SAA.

(37) $\underline{\textit{Only-Bill}\ (A \vee B) \Rightarrow_S \textit{Only-Bill}\ (A) \wedge \textit{Only-Bill}\ (B)}$
No one ≠ Bill drinks or smokes.
Bill drinks or smokes.
Bill drinks and Bill smokes.
Therefore, No one ≠ Bill drinks and No one ≠ Bill smokes.

(38) $\underline{\textit{Only-Bill}\ (A) \wedge \textit{Only-Bill}\ (B) \Rightarrow_S \textit{Only-Bill}\ (A \vee B)}$
No one ≠ Bill drinks and No one ≠ Bill smokes.
Bill drinks and Bill smokes.
Bill drinks or smokes.
Therefore, No one ≠ Bill drinks or smokes.

In fact, all the operators that von Fintel defines as Strawson DE, including conditionals and emotive factives, come out Strawson AA. It is a routine, if tedious, matter to show this (see Appendix 1).

(39) through (41) show that *only NPs*, conditionals, and emotive factives license weak NPIs like *any* and *ever*, but do not license strong NPIs like *in weeks*, *either,* and punctual *until*. See Homer (2009) for similar data.

(39) a. Only John has ever seen anyone.
b. *Only John has seen Mary in weeks.
c. *Only John likes pancakes, either. (Nathan 1999)
d. *Only John arrived until his birthday.

(40) a. If Bill has ever seen anyone, he is keeping it a secret.
b. *If Bill has seen Mary in weeks, he is keeping it a secret.
c. *If Bill likes pancakes, either, he is keeping it a secret.
d. *If Bill arrived until Friday, he is keeping it a secret.

(41) a. Mary is sorry that she ever talked to anyone.
b. *Mary is sorry that she has talked to Bill in weeks.
c. *Mary is sorry that she likes pancakes, either.
d. *Mary is sorry that she arrived until Friday.

(42) I have never gone to Amsterdam. *If I go to BRUSSELS either, I will buy you some chocolates. (Rullmann 2003)

(43) I didn't go to Spain. *I regret that I went to Portugal, either. (Rullmann 2003)

This is puzzling. All of these operators turn out to be Strawson AA; and yet, strong NPIs are not licensed under these SAA operators.[8]

So, what we have learned is that a natural extension of von Fintel's notion of Strawson entailment to the licensing of strong NPIs yields incorrect results. Strawson anti-additivity is too weak to account for the distribution of strong NPIs. Hence it appears that presuppositions must be taken into account when we assess the licensing of strong NPIs. One way to look at this is that a standard notion of entailment that pays attention to presuppositions is used in defining AA, but not DE.

To sum up, Zwarts (1998) and von Fintel (1999) have given us two dimensions to consider in the statement of licensing conditions: standard entailment versus Strawson entailment and downward entailment versus anti-additivity.

(44)

	Entailment	S-entailment
DE	???	Weak NPIs
AA	Strong NPIs	???

We have polarity items sensitive to AA + standard entailment and DE + Strawson entailment. To my knowledge, there are no classes of NPIs in English sensitive to the other two possible classes of licensers. Why would this be so? What do anti-additivity and standard entailment have to do with each other? Why should the two go together?

The above classification is an unattractive way to describe the difference between weak and strong NPIs. We have identified two independent parameters, and we have a different setting for each for the two classes of NPIs: Weak = [Strawson, DE] and Strong = [Standard, AA]. A better theory would tie this two-way distinction to the setting of one binary parameter. This is what I attempt to provide in the next section, arguing that the single distinction between weak and strong NPIs is whether or not they attend to the non-truth-conditional meaning of the licenser.

4 A new approach to the weak/strong distinction

4.1 The basic proposal

In the last section, we have recounted an interesting problem. Apparently we need two independent stipulations to describe the difference between weak and strong NPIs. Strong NPIs require anti-additivity rather than just DE-ness; and strong NPIs are sensitive to presuppositions, whereas weak NPIs are not. In this section I offer an account of the difference between the two classes that relies on a single stipulation: strong NPIs are sensitive to the non-truth conditional meaning of licensers; weak NPIs are not.

My solution to this problem is based on an observation of Chierchia's (2004). Our discussion of Chierchia's approach to intervention in Sect. 3.2.1 was in many ways too simplistic. I presented Chierchia as claiming that an implicature that disrupted the DE character of an NPI's environment prevented licensing of that NPI. That is not quite

[8] Alonso Ovalle and Guerzoni (2004) make a similar observation about n-words in Italian and Spanish.

true, as Chierchia observes. Consider the case of a licenser like *few NP*. *Few* is itself a scalar term and introduces a positive scalar implicature of its own; cf. (45).

(45) Few students smoke.
Implicature: Some students smoke.

This positive implicature, however, does not muck up the licensing of NPIs such as *any* and *ever*; cf. (46).

(46) Few students had any regrets.

Chierchia resolves this issue by suggesting that it is only what he calls 'indirect' implicatures that interfere with licensing. Indirect implicatures are implicatures that are introduced by non-weak endpoint scalar items in the scope of a DE operator; direct implicatures are implicatures introduced by non-strong endpoint scalar items, without interaction with other operators in their environment. For example, the implicature introduced by *few* results directly from the fact that *few* does not occupy the strong endpoint of its scale; *no* is stronger, for example.

Of course, as we observed above with Zwarts, *few NP* does not (typically) license strong NPIs. We also pointed out that Zwarts's idea to require anti-additivity of the licensers of strong NPIs faces empirical problems, as illustrated in (16)–(18), and makes strange bedfellows with von Fintel's Strawson entailment. Chierchia's observation offers us another, more fruitful path. I suggest that while the direct implicatures of licensers do not disrupt the licensing of weak NPIs, they do interfere with the licensing of strong NPIs.

(47) AA licensers: *no NP*, *none*, *never*, *not*, *without*
a. ⟨no, few, not many, not all⟩
b. ⟨never, rarely, not often, not always⟩

This proposal has a clear antecedent in Krifka (1995). Krifka also suggests that anti-additivity is not in fact the relevant property for licensing strong NPIs.[9] He argues that instead the relevant property is being at the end of a DE scale.[10] The underlying reason, according to Krifka, is that strong NPIs are emphatic and that emphatic items need to be in extreme environments, such as the scope of an operator at a (negative) scalar endpoint. This is somewhat vague as an explanation, but the generalization has interesting consequences. If I am correct, strong scalar endpoints license strong NPIs because they do not trigger implicatures.

Now, for sake of comparison with Zwarts's ideas, notice that none of the paradigmatic AA licensers occur on scales that contain stronger items. This leads to the

[9] Note that what Krifka means by strong NPI does not coincide exactly with what Zwarts means. Krifka includes stressed *ANY* in the class of strong NPIs. Stressed *ANY* has a broader distribution than Zwarts's strong NPIs. For example, it can occur in the ostensibly upward entailing complement of *glad*:

(i) I'm glad we got ANY tickets.

[10] See Matsumoto (1995) for an argument that scales must be uniform in monotonicity.

conjecture that the strong endpoint of every DE scale is AA. (Thanks to an anonymous reviewer for suggesting this).

(48) *Conjecture:*
A DE scalar item is AA iff it is the endpoint of its scale.

At this point, it is worth taking note of the determiner *every*. It is AA in its restrictor but does not license strong NPIs; the same is true of the determiner *no*, for that matter.

(49) a. ??Every student who has arrived in weeks smokes.
b. ??No student who has arrived in weeks smokes.

(50) a. Every student who smokes drinks.
*Every student who [writes]$_F$ either drinks.
b. No student who smokes drinks.
*No student who [writes]$_F$ either drinks.

Neither determiner gives rise to a direct implicature, but implicatures are not the only possible sources of problems. It is likely that the reason licensing fails here is a presupposition of existence associated with the restrictors of these determiners (see Diesing 1992, for example). We will revisit the problems for licensing created by presuppositions in Sect. 4.4.

Returning to the analysis of *few NP*, Chierchia (2004, 2006) achieves the separation of direct from indirect scalar implicatures by introducing implicatures recursively in stages. Alongside the plain truth-conditional meaning of a constituent, Chierchia produces a set of strong meanings, which correspond roughly to the plain meaning enriched by one or more implicatures. Chierchia's system includes two separate rules: one that introduces indirect implicatures and one that introduces direct implicatures. The rules are formulated in terms of an enrichment operation O with semantics similar to *only* (Chierchia 2006).[11] The operation takes a proposition F and a set G of alternative propositions as input and outputs the propositions that F is true and that no proposition in G is true except for F's consequences. (51) is a paraphrase of Chierchia's (2006, p. 546) formulation.

(51) *Definition of O*
For F of type $\langle s, t\rangle$ and G of type $\langle\langle s, t\rangle, t\rangle$,
$O(F,G)$ iff $\lambda w.F(w) = 1$ & $\forall A \in G[A(w) = 1 \rightarrow F \vDash A]$.

When the function being applied is DE, the operation O is invoked by the rule of Functional Application. When the function being applied is not DE, no strong meanings are created by Functional Application (52) paraphrases Chierchia's (2006, p. 548) formulation.

[11] Chierchia's proposal builds on a number of previous proposals concerning exhaustification, including Groenendijk and Stokhof (1984), Fox (2003), and van Rooij and Schulz (2004), among many others.

(52) *Strong Functional Application*
If α is a branching node whose daughters are β and γ, where $\llbracket\beta\rrbracket$ is a function whose domain includes $\llbracket\gamma\rrbracket$, and $\llbracket\beta\rrbracket$ is DE,
(i) the plain meaning of $\alpha = \llbracket\beta\rrbracket(\llbracket\gamma\rrbracket)$;
(ii) the set of strong meanings of α includes $\mathrm{O}(\llbracket\beta\rrbracket(\llbracket\gamma\rrbracket), \llbracket\beta\rrbracket)\llbracket\gamma\rrbracket^{\mathrm{ALT}}))$.

In addition to the rule of Strong Functional Application, there is a rule of scalar enrichment that introduces implicatures via O at every node of type t—this naturally includes all scope sites for quantifiers. (53) paraphrases Chierchia's (2006, p. 550) definition.

(53) *Scalar Enrichment*
If the plain meaning of α is a proposition, the set of strong meanings of α includes $\mathrm{O}(\llbracket\alpha\rrbracket, \llbracket\alpha\rrbracket^{\mathrm{ALT\text{-}1}})$.

The ALT function referenced in these definitions generates sets of alternatives by replacing the scalar items of a constituent with its scalemates, using the mechanisms of Rooth (1985). A special variant of the ALT function, which I have dubbed ALT-1, is used in the scalar enrichment rule. ALT-1 only replaces the highest functional scalar item with its alternatives. Thus, at the scope site of a quantifier Q, when Scalar Enrichment applies, it introduces only the implicature triggered by Q.

(54) a. Standard definition of application for ALT function:
$\llbracket\alpha\rrbracket^{\mathrm{ALT}} = \llbracket\beta\rrbracket^{\mathrm{ALT}}(\llbracket\gamma\rrbracket^{\mathrm{ALT}})$
b. Set tolerant application:
Where A is a set of functions whose domains include the members of B, $\mathrm{A(B)} = \{\alpha(\beta)\text{: } \alpha \in \mathrm{A}\ \&\ \beta \in \mathrm{B}\}$

(55) Definition of application for ALT-1 (based on Chierchia 2004, p. 95)

$$\llbracket\alpha\rrbracket^{\mathrm{ALT\text{-}1}} = \begin{cases} \llbracket\beta\rrbracket^{\mathrm{ALT}}(\llbracket\gamma\rrbracket), \text{ if } \llbracket\beta\rrbracket^{\mathrm{ALT}} \text{ is not a singleton} \\ \llbracket\beta\rrbracket(\llbracket\gamma\rrbracket^{\mathrm{ALT}}), \text{ otherwise.} \end{cases}$$

Let's examine how these rules work in a simple instance of composition. Consider how the subject DP composes with the VP in (56). First we apply the rule of strong functional application, which introduces the indirect implicature associated with *and* in the scope of DE *few*.

(56) $[_{\mathrm{DP}}$Few students$]$ $[_{\mathrm{VP}}$smoke and drink$]$.

(57) a. $\llbracket$smoke and drink$\rrbracket^{\mathrm{ALT}} = \{\llbracket$or$\rrbracket(\llbracket$smoke$\rrbracket,\llbracket$drink$\rrbracket), \llbracket$and$\rrbracket(\llbracket$smoke$\rrbracket,\llbracket$drink$\rrbracket)\}$
b. The plain meaning of (56): $\llbracket$Few students$\rrbracket(\llbracket$smoke and drink$\rrbracket)$
c. The set of strong meanings of (56) includes $\mathrm{O}(\llbracket$Few students$\rrbracket(\llbracket$smoke and drink$\rrbracket), \llbracket$Few students$\rrbracket(\llbracket$smoke and drink$\rrbracket^{\mathrm{ALT}}))$

$= \lambda w.[\![\text{Few students}]\!]^{w}([\![\text{smoke and drink}]\!]^{w})$ and $\neg\, [\![\text{Few students}]\!]^{w}$ $([\![\text{smoke or drink}]\!]^{w})$
'Few students smoke and drink but some students do smoke or drink.'

So, the rule of Strong Functional Application derives from (56) the implication that some (or, not few) students engage in at least one of the activities of smoking and drinking.

Next, we apply the rule of scalar enrichment. This rule introduces the direct implicatures associated with the highest scalar item in a constituent. In this case, scalar enrichment introduces the implicature triggered by *few*.

(58) a. $[\![\text{Few students smoke and drink}]\!]^{\text{ALT-1}} =$
$\{[\![\text{No students smoke and drink}]\!],$
$[\![\text{Few students smoke and drink}]\!],$
$[\![\text{Not all students smoke and drink}]\!] \ldots\}$
b. The set of strong meanings of (56) includes
$O([\![\text{Few students smoke and drink}]\!],$
$[\![\text{Few students smoke and drink}]\!]^{\text{ALT-1}})$
$= \lambda w \cdot [\![\text{Few students}]\!]^{w}\ ([\![\text{smoke and drink}]\!]^{w})$ and
$\neg[\![\text{No students}]\!]^{w}\ ([\![\text{smoke and drink}]\!]^{w})$
'Few students smoke and drink but some students do smoke and drink.'

In other words, here scalar enrichment derives from (56) the implicature that some students smoke and drink.

With these principles in mind, let's turn to formulating the licensing conditions on negative polarity items. First, let's formulate a necessary condition that applies to all negative polarity items, weak and strong alike. The motivation for this licensing condition is that all NPIs, weak and strong, are subject to intervention effects triggered by non-weak endpoint scalar items.

(59) *Condition 1*
A negative polarity item v is licensed only if it is contained in a constituent γ such that
(i) γ is contained in a constituent $[_{\alpha}\ \beta\ \gamma]$, and
(ii) $O([\![\beta]\!]([\![\gamma]\!]),[\![\beta]\!]([\![\gamma]\!]^{\text{ALT}}))$ is DE with respect to the position of v.

This principle expresses the idea that an NPI must be contained in a constituent C that is DE with respect to the position of the NPI when the implicatures of all operators in C except for the highest are taken into account.[12] Note that this

[12] There are known problems with this formulation. In particular, the implicatures induced by scalar items c-commanded by the NPI do not interfere with its licensing. See Chierchia (2006, p. 560, fn. 26) for a possible approach.

licensing condition is a blend of environment- and licenser-based conditions. No licenser is formally identified, but the structure of the licensing environment must be taken into account to factor out the implicatures of the highest operator.[13] In (60) I clarify what I mean by "being DE with respect to some position."

(60) *Assessing DE-ness*
$O(⟦\beta⟧(⟦\gamma⟧),⟦\beta⟧(⟦\gamma⟧^{ALT}))$ is DE with respect to the position of v just in case for any μ of the same type as v such that $⟦\mu⟧ \vDash ⟦v⟧$, $O(⟦\beta⟧(⟦\gamma⟧), ⟦\beta⟧(⟦\gamma⟧^{ALT})) \vDash O(⟦\beta⟧(⟦\gamma_\mu⟧),⟦\beta⟧(⟦\gamma_\mu⟧^{ALT}))$, where γ_μ is the result of putting μ in the position of v in γ.

For example, *few students smoke and drink* is not DE with respect to the position of *smoke* by Condition 1, since (61a) does not entail (61b). Obviously we cannot infer from some students smoking that some students smoke Marlboros. Here we substitute *smoke* for v and *smoke Marlboros* for μ in the definition in (60).

(61) a. Few students smoke and drink, but some students do smoke and drink.
b. Few students smoke Marlboros and drink, but some students do smoke Marlboros and drink.

According to Chierchia, this accounts for the impossibility of licensing NPIs in this position.

(62) *Few students smoke any cigarettes and drink.

Now we turn to formulating a necessary condition on the licensing of strong NPIs, which properly includes the condition imposed on weak NPIs. The idea that I would like to formalize is that the direct implicatures introduced by the licenser interfere with the licensing of strong NPIs. Before doing so, we must address another issue. Two anonymous reviewers observe that, descriptively, the implicatures of a DE quantifier Q could include indirect implicatures introduced by scalar items contained in Q's restrictor. We must determine whether or not such implicatures interfere with strong NPI licensing. For example, the implicature induced by *and* in (63) would destroy the DE-ness of *no NP*. This is so since, for example, the fact that some student who smokes or drinks writes does not entail that some student who smokes or drinks writes poems.

(63) No student who smokes and drinks writes.
Implicature: Some student who smokes or drinks writes.

Despite this interference with DE-ness, it appears that such implicatures do not actually disrupt NPI licensing in the scope of *no NP*.

[13] Note that we want a constituent like $[_\alpha[\textit{only NP}]\ \gamma]$ to license weak NPIs in γ. For this to happen, presuppositions must be ignored. In other words, the meanings considered by Condition 1 are purely truth-conditional. We return to the role of presuppositions in Sect. 4.4.

(64) a. No student who smokes and drinks sings.
No student who smokes and drinks writes, either.
b. No student who smokes and drinks has attended class in weeks.

So the conclusion is that indirect implicatures originating in the scope of an operator α interfere with licensing in the scope of α; and direct implicatures of α interfere with the licensing of strong NPIs, but not with weak NPIs; however, indirect implicatures originating in the restrictor of α do not interfere with any licensing in the scope of α.[14]

Note that in Chierchia's (2004, 2006) system indirect implicatures induced by scalar items in the restrictor of a determiner D are introduced locally when D composes with its restrictor, by strong functional application; cf. (52) above.

(65) [O [No student who smokes and drinks]] writes

This may be because the strengthening happens prior to composition with the constituent that contains the NPI which prevents it from interfering—as a result of some cyclic or phase-based principle of interpretation. At this point I can offer no further speculation on this point. I will simply formulate my licensing principles to prevent intervention by the indirect implicatures of a DE quantifier.

Having addressed the empirical question about indirect implicatures of licensers, let's now formulate the necessary condition that applies only to strong NPIs. The idea here is that a strong NPI must meet Condition 1 with the proviso that the constituent that meets Condition 1 must additionally be DE when the implicatures of its highest operator are taken into consideration.

(66) *Condition 2*
A *strong* negative polarity item v is licensed only if it is contained in a constituent γ such that
(i) γ is contained in a constituent $[_\alpha\ \beta\ \gamma]$ and
(ii) $O([\![\beta]\!]([\![\gamma]\!]),[\![\beta]\!]([\![\gamma]\!]^{ALT}))$ is DE with respect to the position of v and
(iii) $O([\![\beta]\!]([\![\gamma]\!]),[\![\beta]\!]^{ALT\text{-}1}([\![\gamma]\!]))$ is DE with respect to the position of v.

Condition (66i) is repeated from Condition 1 in (59). Now, note the crucial use of ALT-1 in the additional condition (66ii) imposed exclusively on strong NPIs. This prevents the alternative-generating mechanism from looking farther down than the highest scalar item in the licenser. In particular, scalar terms in the restrictor of a quantifier are ignored.

In some ways this approach to the distinction between licensing weak and strong NPIs is reminiscent of a suggestion of Homer's (2008, 2009). Homer proposes that weak and strong NPIs are licensed at different points in the computation. In

[14] They do of course intervene for licensing in the restrictor of α:
(i) *No one that every student gave anything was pleased.
This is predicted by the conditions proposed here.

particular he proposes that strong NPIs are sensitive to all non-truth-conditional meaning because they are more 'pragmatic' in nature somehow. The position of the current approach can be seen as a refinement of this position. Strong NPIs are licensed at a later stage than weak NPIs, but as we have seen, strong NPIs are not sensitive to all implicatures. The implicatures triggered by scalar items contained in a licenser do not interfere with licensing. We thus have identified a more precise derivational point at which strong NPIs are licensed.

Another interesting and important feature of this licensing condition is that the only property that it requires of the environment in which a strong NPI occurs is downward entailingness. There is no longer any need to refer to an additional formal property such as anti-additivity. All that the conditions refer to is DE-ness, with different implicatures factored in for different classes of NPIs.

Finally, recall that in endorsing Chierchia's theory we must accept that it is the *potential* for inducing an implicature, and not an actual implicature, that interferes with licensing. Thus we expect that non-endpoint DE operators will fail to license strong NPIs even in the presence of explicit cancellation. Consider the case of *not many NPs*, which typically trigger an existential implicature, as in (67).

(67) Not many students smoke.
Implicature: Some students smoke.

Not many NPs fail to license strong NPIs, even when the implicature is explicitly canceled by an expression such as *if any*. (Thanks to an anonymous reviewer for this example.)

(68) *Not many students, if any, have failed in years.

In this way, the theory under discussion resembles the Ladusaw/Zwarts approach in being about lexical/grammatical features of expressions, as opposed to contextual inferences.

4.2 A complication with scope and intervention

In this section, I have claimed that the direct implicatures triggered by DE operators must be taken into account when assessing the licensing of strong NPIs. I also took care to prevent indirect implicatures triggered by scalar items properly contained within DE operators from interfering with licensing, since it seems that they do not; see (64). I accomplished this by referring to Chierchia's three-stage introduction of implicatures in a tripartite quantificational structure headed by a DE operator: [[F_{DE} Rest] Scop].

At this point I want to make an observation that raises questions about the generality of the approach I have taken here. The approach I have taken suggests that the only implicatures that play absolutely no role in the assessment of licensing are the indirect implicatures introduced by a scalar item contained in the restrictor of a DE licenser. This does not seem to be entirely correct. Consider a simple case of intervention as in (69).

(69) *I doubt that every student$_i$ failed any of his$_i$ exams.
Predicted Implicature: I consider it possible that some student failed some of his exams.

According to Chierchia, the indirect implicature introduced by *every* disrupts the DE-ness of the environment in which *any* occurs, preventing licensing. The same kind of DE-disrupting, positive implicature could be produced by an instance of *every* contained within another operator, as in (70).

(70) I doubt that [a student that read every paper]$_i$ failed any of his$_i$ exams.
Implicature: I consider it possible that some student that read some paper failed some of his exams.

This implicature, however, does not interfere with licensing; (70) is completely acceptable. This is not a direct implicature introduced by a licenser. It is an indirect implicature, introduced at the point in the calculation when the DE function *doubt* is applied—according to Chierchia (2004, 2006). Thus, we predict that it should intervene, but it does not. As mentioned above, Chierchia does suggest how to prevent scalar items c-commanded by an NPI from interfering in its licensing. Yet his system does not, as far as I can gauge, require that for a scalar item to intervene it must c-command the NPI. I leave this problem for future research.[15]

4.3 *Few*: a potential advantage

At this point, I pause to discuss a potential advantage of the new approach to licensing strong NPIs. It is well known that in certain contexts, non-AA functions can license strong NPIs. Zwarts's (1998) approach makes no allowance for this. For example, *few* is DE but not AA. However, many examples of *few NPs* licensing strong NPIs have been put forward in the literature. Consider again (16)–(18), repeated here as (71)–(73):

(71) He was one of the few dogs I'd met in years that I really liked.
(Sue Grafton, *A is for Alibi*, cited in Hoeksema 2006)

(72) Few Americans have ever been to Spain. Few Canadians have either.
(Rullman 2003)

(73) He invited few people$_i$ until he knew she liked them$_i$. (de Swart 1996)

In contrast to Zwarts's, my analysis can make allowances for such cases. I have proposed that operators such as *few NP* fail to license strong NPIs due to an implicature that they trigger. Chierchia (2004) argues that items near the end of a

[15] Chierchia (in prep.) proposes a solution to this problem in terms of minimality in the relation between polarity items and exhaustifiers.

scale can in some contexts behave as if they were the scalar endpoints. As an example, he gives the case of *many NPs* not causing intervention effects. If *many* is on a scale with *some*, it should trigger an implicature in the scope of a DE operator. Yet, intervention effects by *many NPs* are context dependent.

(74) I typically don't have many students with any background in linguistics.

(75) SOME ⟨MANY, EVERY⟩

Chierchia suggests that when (74) is acceptable, it is because, *in the given context*, *many* sits at the endpoint of the scale, as shown in (75). According to Chierchia, a universal quantifier can never count as the weak endpoint of a scale in any context and, thus, always intervenes. This follows from Chierchia's axiom on scale structure that says that a scale must always contain at least two items.

This suggests that negative scales can be truncated in context as well. So *few*, being just above *no*, may serve as the strong endpoint of the negative scale. In such a context, *few* generates no implicature. Chierchia (2004, p. 69) justifies leaving *some* off of *many*'s scale in the following way: "What enables us to truncate a scale at the low end [...] is that small amounts may be functionally equivalent to nothing."

I propose to transpose Chierchia's reasoning about *not* ... *many* to the case of *few;* cf. (77). In the same contexts that allow *some* to be left off *many*'s scale in the scope of a DE operator, let *no* be allowed to be left off *few*'s scale, as in (78).[16]

(77) Typically, few students in my class take an interest in semantics.

(78) NO ⟨FEW, NOT EVERY⟩

Consequently, *few* can license strong NPIs when context permits.

This is all a bit vague though. Let me propose a precise restriction on when a negative operator can act like a strong scalar endpoint.

(79) *Condition on truncation of negative scales*
To be able to act as a strong scalar endpoint a scalar item must be close enough to the endpoint.

I propose that to be considered "close enough," a scalar item must be *Intolerant* (see Löbner 1987, Horn 1989[17]). Horn (1989) uses the concept of Intolerance to identify

[16] Note that this violates Chierchia's (2004, p. 69) scale axiom (i):

(i) In any given context where we utter a sentence S, containing a scalar term α:
if possible, α must not be the strongest element of the chosen scale.

Chierchia discusses the case of positive scales. Perhaps the axiom must be reversed for negative scales.

[17] See also Zwarts's (1998) discussion of the Law of Contradiction.

those items that are above the midpoint of a scale. A function F is Intolerant just in case for every element x in F's domain, F maps either x to 0 or the complement of x to 0. A consequence of this is that an Intolerant function cannot map both x and x's complement to 1. This provides an interesting precedent for our account of being near the endpoint of a scale. (80) is my proposal based on Horn's idea (Horn 1989, p. 237).

(80) A function f of type $\langle\langle e, t\rangle, t\rangle$ is *Intolerant* iff if f is not *trivial,*[18] then for all x of type $\langle e, t\rangle$, $f(x) = 0$ or $f(\neg x) = 0$.

(81) A function f is trivial iff for all x, $f(x) = 1$ or for all x, $f(x) = 0$.

On its proportional reading, *few NP* is plausibly Intolerant. *Fewer than 4 NP* is not; (83) can be true if I have at most six friends.

(82) a. #Few of my friends are linguists and few of them aren't. (Horn 1989)
b. #He rarely goes to church and he rarely doesn't go. (Horn 1989)

(83) Fewer than 4 of my friends are linguists and fewer than 4 aren't.

Thus, while *few NP* may license strong NPIs, *fewer than n NP* may never—though see Sect. 4.5 below.

Some readers who remain unconvinced by the details of my story might still be interested in DE + Intolerant as an intermediate category of negation between DE and AA. In fact, the following inclusion relations hold.

(84) AA $\subset$ DE + Intolerant $\subset$ DE

Finally, I find additional support for the proposed condition on scale truncation in (79) in the details of the NPI-licensing properties of *few*. Partee (1989) argues that *few* is ambiguous between a proportional and a cardinal reading. On its cardinal reading, *few* has a meaning like (85a); on its proportional reading, like (85b).

(85) a. $[\![few]\!]$ (A)(B) = 1 iff $|A \cap B| < n$, where n is small.
b. $[\![few]\!]$ (A)(B) = 1 iff $|A \cap B| < n \cdot |A|$, where $n<1$ and n is small.

The cardinal reading is not Intolerant, but the proportional reading is—whenever n is less than ½. So, in environments where the cardinal reading is forced, *few NP* should not be able to license strong NPIs. Existential *there*-sentences have been argued to force the cardinal reading of *few*. Thus we predict, correctly, that (86b) is ungrammatical.

[18] I include this clause to bring out the inclusion relations in (84). See Appendix 2 for proof that AA $\subseteq$ DE + Intolerant.

(86) a. There were few potatoes in the pantry.
b. ?*There were few in the refrigerator, either.

This shows, I believe, that cardinal *few* never licenses strong NPIs. In Sect. 4.5 we turn to possible problems for the current proposal raised by certain numeral quantifiers. First, however, in the next section, we explore extensions of the present account concerning implicatures to cases of presupposition.

4.4 The role of presuppositions in NPI licensing

In this section, we discuss the role that presuppositions play in the licensing of NPIs. As I discussed above in Sect. 3.2.2, Homer (2008, 2009) shows that presuppositions can interfere in the licensing of NPIs. However, Homer shows that the picture is not as simple as I have presented it above. Some presupposition triggers fail to cause intervention effects. Consider (88), which contrasts with (87).

(87) *I don't think [John]$_F$ read anything interesting, too.

(88) a. I don't think John [ate anything interesting] again.
b. Presupposition: John ate something interesting before.

Here the meaning of *eat* strongly biases the narrow scope reading of *anything* with respect to *again*. So we would expect the presupposition introduced by *again* to interfere with NPI licensing since it would break DE-ness as discussed above. Homer suggests that some triggers produce intervention effects and some do not. The mechanism by which this is accomplished is left for future research.

With this idea in mind, let us turn to the presuppositions of licensers and the roles that they do or do not play in NPI licensing. The insight in von Fintel (1999) is that the presuppositions of licensers do not interfere with NPI licensing. Homer suggests that there are cases in which the presuppositions of a licenser do interfere with the licensing of NPIs like *any* and *ever*. The cases Homer has in mind are *both* and the singular definite article.

As Giannakidou (2004) observes, *both* and singular *the* are both predicted to be Strawson DE with respect to their restrictors.

(89) The boy smokes.
There is exactly one tall boy.
∴ The tall boy smokes.
Both students smoke.
There are exactly two music students.
∴ Both music students smoke.

This is a potential problem for von Fintel. Lahiri (1998), however, offers a solution. He observes that in addition to being Strawson DE, *both* and *the* are also Strawson upward entailing with respect to their restrictors. He then suggests that the correct licensing condition for weak NPIs is that they should be in an environment that is Strawson DE, but not Strawson UE.

Homer argues for taking another route. He suggests that the presuppositions of *both* and singular *the* are interfering with the licensing of weak NPIs, just like an intervener. In other words, the presuppositions of *only* behave like the presuppositions of *again*, while the presuppositions of *both* behave like *too*. Thus the role they play in licensing is attributed to an as yet unexplained asymmetry in presupposition triggers.

The hypothesis put forward in Chierchia (2004) and this paper suggests yet another route. First, notice that Homer's account of *both* and singular *the* takes for granted that there is something for the presuppositions of these operators to interfere with. In other words, Homer takes it for granted that the truth-conditional meaning of *both* and *the* is DE with respect to their restrictors, as in (90). This is not at all obvious. While the truth-conditional component of these operators' meanings may be purely universal, as in (90), it is also conceivable that existence is a part of their meaning, as in (91).[19]

(90) a. $[\![\textit{both}]\!](A)(B)$ is defined only if $|A| = 2$.
When defined, $[\![\textit{both}]\!](A)(B) = 1$ iff $A \subseteq B$.
b. $[\![\textit{the}_{sg}]\!](A)(B)$ is defined only if $|A| = 1$.
When defined, $[\![\textit{the}_{sg}]\!](A)(B) = 1$ iff $A \subseteq B$.

(91) a. $[\![\textit{both}]\!](A)(B)$ is defined only if $|A| = 2$.
When defined, $[\![\textit{both}]\!](A)(B) = 1$ iff $A \neq \emptyset$ & $A \subseteq B$.
b. $[\![\textit{the}_{sg}]\!](A)(B)$ is defined only if $|A| = 1$.
When defined, $[\![\textit{the}_{sg}]\!](A)(B) = 1$ iff $A \neq \emptyset$ & $A \subseteq B$.

If that were the case, there would be no reason to think that the presuppositions interfere with licensing. The meaning of the determiners stripped of presuppositions would not be adequate to license NPIs in their restrictors.

If this is a plausible line to take on *both* and *the*, it opens the way to extracting a new generalization from Homer's data. To wit, the presuppositions of DE operators/licensers never interfere with the licensing of weak NPIs. This is congenial to the view presented in this paper, since it mirrors Chierchia's observation that implicatures triggered by a licenser do not interfere with the licensing of weak NPIs.[20]

I will attempt to formalize the necessary conditions on NPI licensing induced by presuppositions. To do so requires ignoring the presuppositions of some constituents in the licensing conditions. The simplest way to proceed is in a two-dimensional semantic system, in which each expression α is paired recursively with a plain truth-conditional meaning $[\![\alpha]\!]_T$ and a presuppositional meaning $[\![\alpha]\!]_P$. For convenience, I make use of the well-known system proposed by Karttunen and Peters (1979). The

[19] See Yablo (2005) for a particularly interesting discussion of the content of singular definites in the context of what he calls 'non-catastrophic' presupposition failure. Yablo essentially proposes (91b).

[20] See Chierchia, in prep., for a fuller discussion of a different way to preserve the generalization that the presuppositions of licensers do not interfere with the licensing of weak NPIs.

crucial principle of their semantic system is their rule of functional application. (92) is a paraphrase of their Montagovian Rule 4 (Karttunen and Peters 1979, p. 49).

(92) *Karttunen & Peters Application*
If α is a branching node whose daughters are β and γ, and $[\![\beta]\!]_T$ is a function whose domain includes $[\![\gamma]\!]_T$, then
$\langle [\![\alpha]\!]_T, [\![\alpha]\!]_P \rangle = \langle [\![\beta]\!]_T([\![\gamma]\!]_T), [\![\beta]\!]_P([\![\gamma]\!]_T) \wedge h([\![\beta]\!]_T, [\![\gamma]\!]_P) \rangle$

This rule assigns to a node a conjunction of presuppositions: the first is the presupposition projected from the applied function, $[\![\beta]\!]_P([\![\gamma]\!]_T)$; the second is the presupposition projected from the argument as filtered by the function, $h([\![\beta]\!]_T, [\![\gamma]\!]_P)$. The function h is Karttunen and Peter's heritage function, which determines what becomes of the argument's presupposition, as partially determined by the applied function. This conjunction provides a convenient parallel with implicatures. I suggest that all negative polarity items are sensitive to the presence of the second conjunct of the presupposition, originating from the argument. Strong negative polarity items, however, are also sensitive to the first conjunct of the presupposition, which is contributed by the function. These licensing conditions for weak and strong NPIs are formalized in (93) and (94), respectively.

(93) *Condition 3*
A negative polarity item *v* is licensed only if it is contained in a constituent γ such that
(i) γ is contained in a constituent $[_\alpha\ \beta\ \gamma]$ and
(ii) $[\![\beta]\!]_T([\![\gamma]\!]_T) \wedge h([\![\beta]\!]_T, [\![\gamma]\!]_P)$ is DE with respect to the position of *v*.

(94) *Condition 4*
A *strong* negative polarity item *v* is licensed only if it is contained in a constituent γ such that
(i) γ is contained in a constituent $[_\alpha\ \beta\ \gamma]$ and
(ii) $[\![\beta]\!]_T([\![\gamma]\!]_T) \wedge h([\![\beta]\!]_T, [\![\gamma]\!]_P) \wedge [\![\beta]\!]_P([\![\gamma]\!]_T)$ is DE with respect to the position of *v*.

Once again, downward entailingness is the only formal property of licensing environments required by these conditions, though the conditions attend to different features of the environment. Also, like the conditions in (59) and (66), these are merely necessary conditions for licensing. Together, however, Conditions 1 (cf. (59)) and 3 (cf. (93)) are possibly jointly sufficient for the licensing of a weak NPI. Likewise the conjunction of Conditions 2 (cf. (66)) and 4 (cf. (94)) is a good candidate for a sufficient condition for the licensing of strong NPIs.

We, like Homer, are still left with the problem of why presupposition triggers like *again* do not cause intervention effects. I have nothing to say about this problem here. We have however, brought some order to Homer's cases by systematically excluding the presuppositions of licensers from intervening.

4.5 Potential challenges

The statement of our new theory—according to which strong NPIs are licensed by DE-ness when certain aspects of non-truth-conditional meaning are taken into account—raises the possibility of treating certain licensers in new ways. We need to be sure that expressions that do not license strong NPIs are still predicted not to. A case in point are the comparative quantifiers discussed in Sect. 4.5.1. Then in Sect. 4.5.2, I suggest a new perspective on a problem that plagues semantic accounts of licensing: the semantic equivalence of *no* and (*exactly*) *zero*. This perspective helps us to deal with a potential problem presented by explicit proportional quantifiers.

4.5.1 Comparative quantifiers

What the present theory really says now is that strong NPI licensers are DE operators that introduce neither presuppositions nor (local) quantity implicatures.[21] I have suggested identifying this set of licensers with the set of strong endpoints on DE scales. But I may have suggested this identification too quickly. Might there be DE operators that are not scalar endpoints but also do not introduce implicatures? As far as I can tell there are two possibilities. The first possibility: the operator is not a member of a scale (see Chierchia's 2004 analysis of *if*-clauses). The second possibility: the operator qualifies as a member of a scale, but does not give rise to an implicature. The second possibility may well be attested. Krifka (1999) and Fox and Hackl (2006) (henceforth F&H) suggest that some scalar expressions do not give rise to implicatures.

F&H suggest that the reason the implicatures do not arise is that admitting such implicatures would lead to contradiction. We need not go into all the technical details, but it is worth sampling the flavor of their analysis.[22] The case they focus on is that of comparative quantifiers, such as *more than n*. While (95) gives rise to the implicature that Mary didn't eat four cookies, the roughly equivalent (96) does not.

(95) Mary ate three cookies.
Implicature: Mary didn't eat four cookies.

(96) Mary ate more than two cookies.
#Implicature: Mary didn't eat four cookies.

They suggest that this judgment is supported by the following contrast (in their view implicatures are introduced by an operator with semantics similar to those of *only*).

[21] Note that this statement is not completely accurate. Not just any presupposition associated with a function will prevent it from licensing strong NPIs. For example, if there is an existence presupposition associated with *no student* that will *not* stand in the way of the function's DE-ness, it will still license strong NPIs in its scope.

[22] I present F&H for convenience. There are a variety of solutions to the problem with roughly the same structure; see Fox (2008) for discussion. The way I reconcile my account with F&H would work for these others as well.

(97) a. Mary only ate $[\text{three}]_F$ cookies.
b. #Mary only ate more than $[\text{two}]_F$ cookies.

F&H suggest that no implicature is derived from *more than n* because running the usual implicature generation mechanism leads to a contradiction. Such a contradictory strengthened meaning is useless and is, therefore, discarded. How does the contradiction arise? F&H suggest that the relevant alternatives to *more than n* are *more than m* for some number m. Furthermore, they suggest that the default output of scalar implicature is the negation of all stronger alternatives.

(98) Mary ate more than 3 cookies.
Mary ate more than m cookies.
NOT(Mary ate more than m cookies), for all $m > 3$

The negation of all stronger such alternatives is incompatible with the truth conditions of the original statement, under the assumption that the domain of number alternatives is dense. In other words, between any two alternatives on the scale there exists another alternative. In fact, F&H suggest that in natural language all measurement domains are dense:

(99) *Universal Density of Measurement:*
Measurement scales needed for natural language semantics are always dense. (F&H, p. 542)

Saying that Mary ate more than 3 cookies implies that she ate n cookies for some $n > 3$. If we then say, however, that *Mary ate more than m cookies* is false for all $m > 3$, we run into a contradiction. Because the domain of numbers is dense there is a number ε between 3 and n. But *Mary ate more than* ε *cookies* must be false since $\varepsilon > 3$. That implies that Mary didn't eat more than ε cookies. But $n > \varepsilon$.

F&H also discuss the case of negated numerals:

(100) Bill didn't smoke 30 cigarettes.
#Implicature: Bill smoked 29 cigarettes.

According to F&H, *not n* is interpreted as *fewer than n*. Their account of the lack of implicatures for *more than n* extends directly to *fewer than n*, so that no implicature is generated in (100).

Krifka (1999), on the other hand, explicitly claims that negative comparative quantifiers, such as *fewer than/at most n NP*, do not give rise to implicatures. If this is true, it is incompatible with the view of NPI-licensing being put forward here. *Fewer than n* is DE; if it does not introduce an implicature we predict it should license strong NPIs. This is not the case (though see Krifka 1995[23]):

[23] Krifka (1995) suggests (i) can be good (he takes stressed *at all* to be a strong NPI):

(i) Fewer than three students talked AT ALL.

(101) *Fewer than 3 students have visited in weeks.

One way out for us is to suggest that, even though comparative quantifiers do not introduce the *same* implicatures as bare numerals, they do introduce *some* implicature. For example, (100) clearly implicates that Bill smoked some cigarettes, if not 29. It may be that (102) also introduces such an existential implicature.

(102) Fewer than 10 students attended the colloquium.

To my ear, (102) introduces the implicature that some students attended the colloquium. Of course, in some contexts this implicature, like any other, can be canceled. Krifka (1999) admits that sentences like (102) typically give rise to an existential inference. He supports this with evidence from anaphora. In particular, he claims that it is (almost) natural to follow the statement in (103a) with reference in (103b) to the entity introduced by the existential contribution of *fewer than 3 students*.

(103) a. Fewer than 3 students left early.
b. ?And *they* only left because they felt ill.

Krifka, however, takes this existential inference to be a presupposition. I am not convinced that this is a presupposition. Consider the following tests. First, there is von Fintel's (2004) *Hey wait a minute* test. It sounds quite odd to object to (103a) with (104a). This suggests that negative comparative quantifiers do not carry an existential presupposition. If existence were being taken for granted, such an objection should be felicitous.

(104) #Hey wait a minute! I had no idea some students left early.

Furthermore, the existential inference does not project like a presupposition. For example, (105) ought to carry the presupposition that Mary believes some students will walk out on her talk (cf. Heim 1992). This does not appear to be the case.

(105) Mary wants fewer than 3 students to walk out on her talk.

As I have said above, I believe that the existence inference is an implicature. But if Fox and Hackl are correct, (106) holds.

(106) For any predicate P,
$O([\![\text{fewer than 3 students}]\!](P), [\![\text{fewer than 3 students}]\!]^{ALT}(P)) = \perp$

If all implicatures are introduced by O, this suggests that *fewer than 3 students* cannot introduce an implicature. I suggest that if the strengthening operator O produces inconsistency, a weaker one (W-O) steps in to generate an existential implicature:

(107) $\text{W-O}([\![\alpha]\!],[\![\alpha]\!]^{ALT}) =$
$\lambda w.[\![\alpha]\!](w) = 1 \ \& \ \exists p \in [\![\alpha]\!]^{ALT}[p(w) = 0]$

In this way, we can say that negative comparative quantifiers, such as *fewer than n NP,* give rise to an existential implicature. This existential implicature interferes with DE-ness in the same way as *only*'s presupposition. Hence we predict that negative comparative quantifiers will not license strong NPIs, though they do license weak NPIs. In the next section, we turn to the difficult case of operators like *zero* and explicit proportions.

4.5.2 Zero and explicit proportions

Semantic accounts of strong NPI licensing are haunted by the problem of semantic equivalence. While *no* is ostensibly semantically equivalent to *fewer than one* and *zero*, only *no* licenses strong NPIs in its scope.

(108) $[\![\text{no}]\!] = [\![\text{fewer than one}]\!] = [\![\text{exactly zero}]\!]$

(109) a. *Fewer than one student has visited me in years.
b. *Exactly zero students have visited me in years.

My theory does no better than an AA theory here, since *fewer than one student* does not intuitively give rise to an interfering existential implicature. One possible response is to follow Fox and Hackl (2006) in assuming that all measurement domains are dense. The system will produce an implicature like '.3 students left' but the implicature doesn't see the light of day once it confronts our world knowledge about counting students.

This is fine for *fewer than one NP*, but it will not work for (*exactly*) *zero NP*. Here is an alternative that could take care of *zero NP*. Suppose the grammar (and the implicature-generating mechanism as a part of it) cannot distinguish one numeral from another. The grammar knows degree domains are ordered and possibly dense but doesn't know the names of degrees. Recall that functions like $[\![$*zero students*$]\!]$ are intuitively DE (even AA) and do not give rise to positive implicatures, but neither do they license strong NPIs. In fact, there are many ways in which (*exactly*) *zero* behaves differently from *no*:

(110) Zero students left early.
No/*Zero students like SEMANTICS, either.

(111) a. On no/*zero occasion(s) did he mention my help. (Deprez 1999)
b. No/*Zero students but Bill came. (Moltmann 1995)
c. She drank no/*zero martinis, not even weak ones. (Postal 2004)

(112) ?Zero students said anything.

We could explain this if the grammar sees *zero* as just another number, like *64*. Suppose that the grammar only ascribes a property to an expression containing a numeral *n* if it has that property on all values for *n*. Since (*exactly*) *n* is not Intolerant on all values, the grammar does not acknowledge it as such. Therefore, (*exactly*) *zero* cannot serve as the endpoint of a scale.

Now we turn to a problem with the Intolerance condition. I argued for Intolerance as a line dividing DE quantifiers that could act as endpoints from those that could not. Explicit proportionals like (113) are a problem. *Fewer than 1/3 of the NP* is indeed Intolerant, but does not license strong NPIs.

(113) *Fewer than 1/3 of the students have visited in weeks.

Perhaps the grammar is not good at working out explicit proportions. Fox (2000) (see also Gajewski 2002; Fox and Hackl 2006) argues for a similar conclusion on the grounds that wide scope is possible with respect to negation for the object quantifier in e.g. (114a). I refer the reader to Fox for the detailed arguments. The reason this is of interest is that Fox's economy conditions only allow a quantifier to take wide scope if the reading thereby derived is distinct from the narrow scope reading. In (114a), this is not the case.

(114) a. Rob doesn't speak more than half of the 9 languages spoken in Sydney. (Fox 2000)
b. Rob doesn't speak 5 of the 9 languages spoken in Sydney.

Fox tentatively argues that the grammar, which evaluates violations of the economy condition, does not have access to the mathematical content of words such as *half*. My own tentative conjecture, extending Fox's observation to the case of (114b), is that the grammar cannot ascribe different grammatical properties to expressions just because they contain different numeral expressions.

In this section, we have tentatively addressed potential counterexamples to the new theory under consideration. In the next section, we turn to discussion of the alternative proposal of Giannakidou (2006) concerning the distribution of strong NPIs in English.

5 Giannakidou (2006)

Giannakidou (2006) also addresses the distinction between strong and weak NPIs. She argues that strong NPIs are licensed by being in the scope of nonveridical, specifically antiveridical, operators; cf. (116).

(115) *(Non)veridicality for propositional operators*

i. A propositional operator F is veridical iff Fp entails or presupposes that p is true in some individual's epistemic model ME(x); otherwise F is nonveridical.

ii. A nonveridical operator F is *anti*veridical iff Fp entails that *not p* in some individual's epistemic model: $Fp \rightarrow \neg p$ in some ME(x). (Giannakidou 2006, p. 589)

(116) *Licensing by nonveridicality*

A polarity item α will be grammatical in a sentence S iff α is in the scope of a nonveridical operator β in S. (Giannakidou 2006, p. 592)

How to extend nonveridicality to non-propositional operators is a matter that has not been resolved to my satisfaction. Nor is it clear that antiveridicality picks out the right class of licensers as delineated by Zwarts (1998). However, let's put that aside; see Appendix 3 for discussion.

Giannakidou observes that Strawson DE operators such as *only* do not license strong NPIs. She does not endorse Strawson entailment, but rather analyzes *only* in the spirit of Atlas (1991, 1993). This means that she assumes the truth of the prejacent to be part of the truth conditions of an *only*-statement (cf. Giannakidou 2006, p. 594).

(117) *Only a P* asserts:

$\exists x \forall y[(x = y \leftrightarrow Py) \,\&\, (Py \rightarrow y = a)]$

= Exactly one individual, and no one other than a, has the property P.

Which *entails* the positive proposition: P(a)

(after Atlas 1991, 1993)

This means, in her terms, that *only* is veridical, so cannot license strong NPIs. *Only* of course *does* license weak NPIs—this was the motivation for von Fintel's Strawson DE account. Consequently, Giannakidou (2006) suggests that weak NPIs need not be licensed, but can be *rescued* by a negative proposition made available by the sentence containing the weak NPI.

(118) *Rescue by nonveridicality*

A PI α can be rescued in the scope of a veridical expression γ in a sentence S, if (a) the global context C of S makes a proposition S′ available which contains a nonveridical expression β; and (b) α can be associated with β in S′. (Giannakidou 2006, p. 596)

She states: "In the case of *only*, we saw that the nonveridical proposition is an entailment of the sentence (the non-cancelable exclusive conjunct); in the case of negative emotive factives it is possibly a conventional implicature (a counterfactual containing negation)."

This account inherits all the problems of a negative implicature licensing system, like Linebarger (1987). Despite Giannakidou's claims, her system faces the problem of overgeneration that was never resolved in Linebarger's theory. The problem is that there are many entailments of any given proposition and many different possible representations for those propositions. Consider a relatively simple case like *both*. As we have seen, *both* licenses NPIs neither in its restrictor nor in its scope:

(119) a. *Both students with any sense left.
b. *Both students read anything.

It is hard to see, however, how Giannakidou avoids rescuing the *both*-NPIs in (119a) and (119b). Consider, for example, that the global context of (120a) surely makes available the proposition expressed by (120b). Under usual understandings of entailment, (120a) entails (120b).

(120) a. Both students smoke.
b. Some students smoke.

Of course, this same proposition can be expressed by other sentences of English. For example, (121) is another way to say that there are smoking students.

(121) Not every student doesn't smoke.

Here the presence of non-veridical predicate negation ought to be sufficient to rescue *any* in the scope of *both NP*. Similarly, *every* is a non-veridical determiner and should also rescue NPIs in the restrictor of *both*. Examples of this kind can be produced at will. Hence, it is difficult to see how such a theory can be restrictive without an explicit theory about the canonical representation of propositions made available by the context.

6 Conclusion

In this paper, I have written a new set of licensing conditions for weak and strong NPIs, paying special attention to the role played by non-truth-conditional meaning. This work has built especially on the recent works of von Fintel (1999), Chierchia (2004), Gajewski (2005, 2007), and Homer (2008, 2009). The special contribution of the present paper is its argument that the direct scalar implicatures of licensers interfere with the licensing of strong NPIs. This paper has also addressed the role that the presuppositions of licensers play in licensing weak NPIs. I side with the spirit of von Fintel (1999), against Homer (2008), in suggesting that the presuppositions of licensers never interfere in the licensing of weak NPIs. This is analogous to the way that the direct scalar implicatures of licensers do not interfere with the licensing of weak NPIs.

Appendix 1: Strawson anti-additivity

In this appendix, I summarize von Fintel's (1999) analyses of adversatives, conditionals and demonstrate that they turn out to be Strawson anti-additive. First, here are some preliminary definitions. We begin with the definition of an ordering relation on worlds:

For any set of propositions P, we define a strict partial order $<_P$:

$$\forall w', \forall w'': (w' <_P w'' \text{ iff } \forall p \in P\ (w'' \in p \rightarrow w' \in p \text{ and}$$
$$\exists p \in P\ (w' \in p\ \&\ w'' \in p))$$

Or, in plain English:

w′ is better than w″ according to P iff all propositions in P that hold in w″ also hold in w′ but some hold in w′ that do not also hold in w″.

For a given strict partial order $<_P$ on worlds, we now define the selection function max_P that selects the set of $<_P$-best worlds from any set X of worlds:

$$\forall X \subseteq W: max_P(X) = \{w \in X: \sim\exists w' \in X: w' <_P w\}$$

With these in mind, von Fintel gives the semantics of the adversative predicate *sorry*. This lexical entry includes several presuppositions: that the complement of *sorry* denotes a proposition the subject believes, that the contextually supplied modal base includes the subject's belief worlds, and that the modal base is compatible with the complement of *sorry* and its negation.

$[\![sorry_i]\!]^{f,g}(p)(a)(w)$ is defined only if
(i) $DOX(\alpha,w) \subseteq p$
(ii) $DOX(\alpha,w) \subseteq f_i(\alpha,w)$
(iii) $f_i(\alpha,w) \cap p \neq \varnothing$
(iv) $f_i(\alpha,w) - p \neq \varnothing$

If defined, $[\![sorry_i]\!]^{f,g}(p)(a)(w) = \text{True iff } \forall w' \in max_{gi(\alpha,w)} f_i(\alpha,w): w' \in p$.

The truth conditions state that none of the best worlds in the modal base given a contextually supplied ordering source are worlds in which the complement of *sorry* is true.

Now we can also give von Fintel's semantics for conditionals. The crucial notion here is the modal horizon. A modal horizon is a set of worlds closed under an ordering source, as follows.

Admissible modal horizons
A function D from worlds to sets of worlds is an admissible modal horizon with respect to the ordering source g iff
for any world w, $\forall w' \in D(w): \forall w''(w'' \leq_{g(w)} w' \rightarrow w'' \in D(w))$.

The conditional modal *would* is then defined in terms of a modal horizon.

$[\![would_i]\!]^{D,g}$ (if p)(q)(w) is defined only if
(i) D_i is admissible with respect to g_i
(ii) $D_i(w) \cap p \neq \varnothing$

If defined, $[\![would_i]\!]^{D,g}$ (if p)(q)(w) = True iff $\forall w' \in D_i(w) \cap$ p: q(w) = True.

Actually, it is not difficult to convince yourself that these meanings are Strawson AA. First, recall that being (Strawson) DE entails one direction of the equivalence that defines (Strawson) AA. Therefore, to prove that a DE function is AA all we have to prove is the other direction, i.e., $F(A) \wedge F(B) \Rightarrow F(A \vee B)$. Von Fintel has shown at length that adversatives and *would*-conditionals are Strawson DE. All we need to show is that wide-scope conjunction Strawson-entails narrow-scope disjunction. This is easier to do than one might at first imagine. All we really need to do is look at the truth conditions. Why? Consider how Strawsonian reasoning works. To evaluate Strawson entailment you set up an argument whose premises include the truth conditions of the would-be entailer. If the truth conditions entail the truth conditions of the would-be entailee, the argument is valid. Why? It is a well-established result of logic that entailment is preserved under the addition of premises. Strawsonianism just adds the presuppositions of the arguments as premises.

The truth conditions of *sorry* say that the embedded proposition is disjoint from the set of g-best worlds in f. If P is disjoint from this set and Q is disjoint from this set, then $P \cup Q$ will be disjoint as well. So, $[\![sorry_i]\!]^{f,g}$(_)(a)(w) is a Strawson AA function.

The truth conditions for *would*-conditionals say that the intersection of the antecedent proposition P with the modal base D is a subset of the consequent proposition R. If $P \cap D \subseteq R$ and $Q \cap D \subseteq R$, then $(P \cup Q) \cap D \subseteq R$ (note that $(P \cup Q) \cap D = (P \cap D) \cup (Q \cap D)$). So, $[\![would_i]\!]^{D,g}$ (if _)(q)(w) is a Strawson AA function.

Appendix 2: AA $\subseteq$ DE + Intolerant

Assume f is AA.

1. Suppose f is not trivial, i.e., $\exists x\ f(x) = 1\ \&\ \exists x\ f(x) = 0$.
2. Now suppose for reductio that $f(a) = 1\ \&\ f(\neg a) = 1$ for arbitrary a.
3. Notice that $a \vee \neg a = U$, that is, the top element in the domain.
4. Since f is AA, it follows that $f(a \vee \neg a) = f(a) \wedge f(\neg a)$.
5. Since $a \vee \neg a = U$, and given that $f(a) = 1$ and $f(\neg a) = 1$, it follows that $f(U) = 1$.
5. But, being AA, f is DE. So, for all y such that $y \Rightarrow U$, $f(y) = 1$.
6. But all y are such that $y \Rightarrow U$, so for all y, $f(y) = 1$.
   (This contradicts our assumption that f is not trivial.)
   So, for all z, $f(z) = 0$ or $f(\neg z) = 0$.

Therefore, f is Intolerant.

Appendix 3: Generalizing antiveridicality

In my view the question of how veridicality and related notions should be extended beyond propositional operators has not been adequately addressed. Giannakidou's published remarks on verdicality and determiners are suggestive. Bernardi (2002) gives the most complete attempt, though problems remain. I will define veridicality recursively for all conjoinable types, more or less as Bernardi does, and note some of the difficulties.

Let's begin by discussing how a determiner could be veridical. The restrictor of a determiner is not propositional; it denotes a property. Giannakidou (1998) suggests that a determiner is veridical if it entails that the restrictor is not empty. This suggests a way that we could extend veridicality to all conjoinable types: in the event that the argument A of an operator Op is not propositional, Op is veridical if the output of applying Op to A entails the existential closure of A. I formalize this idea below. Assume that t is the type of propositions, and that conjoinable types are defined as in (122). We begin with the standard definition of veridicality in (123).

(122) *Conjoinable types*
   a. t is a propositional type.
   b. If α is a propositional type and β is any type, $\langle\beta,\alpha\rangle$ is a propositional type.

(123) *Veridicality*
   A function F of type $\langle t, t\rangle$ is *veridical* iff for all p of type t, F(p) entails p.

Now we extend this as suggested above, to arrive at (124). A function whose argument is a conjoinable type is veridical if and only if the result of applying the operator to an argument G entails the existential closure of G.

(124) *Veridicality* (*revised*)
   A function F of type $\langle\alpha, \beta\rangle$, where α and β are propositional types, is *veridical* iff for all G of type α, F(G) entails* ExClo(G).

For this to make sense, we must provide a recursive definition of existential closure that applies to all conjoinable types. This is supplied in (125). Essentially this definition just feeds a function of a conjoinable type existentially closed arguments until a proposition pops out.

(125) *Recursive definition of existential closure* (*ExClo*)
   a. If p is type t, ExClo(p) = p.
   b. If α is any other propositional type, then $\alpha = \langle\beta,\gamma\rangle$, where γ is a prop. type and $\text{ExClo}(\alpha) = \exists x \in D_\beta\, [\text{ExClo}(\alpha\,(x))]$.

Furthermore, we need to take care in how we define entailment so that it works in our definition of veridicality. Notice, for example, that for a determiner to be veridical, we have to say how the result of applying it to a restrictor, i.e. a quantifier, can entail a proposition. I think the idea is that no matter what the second argument of the determiner is, the resulting proposition should entail the existential closure of the restrictor. Consider the example of *some* in (126).

(126) For any F, $[\![some]\!]$ (F) is veridical because for any G: *some Fs are Gs* entails that there are Fs.

(127) If β is a propositional type and the type of α ends in the type of β,
if α and β are type t, then
α entails* β iff α entails β;
if α and β are the same type $\langle \mu, v \rangle$ where v is conjoinable,
α entails* β iff for all γ of type μ, α (γ) entails* β (γ);
if the type of α is $\langle \mu, v \rangle$, where μ ends in the type of β,
then α entails* β iff for all v of type μ, α (γ) entails* β.

(128) A type μ ends in type v, if
a. $\mu = v$, or
b. $\mu = \langle \beta, \gamma \rangle$ where γ ends in v.

Now it is simple to define nonveridicality simply as the negation of veridicality.

(129) *Nonveridicality*
A function F of type $\langle \alpha, \beta \rangle$, where α and β are propositional types, is *nonveridical* iff F is not veridical.

So, a determiner is nonveridical if it does not entail the existence of a member of the restrictor. Similarly, a quantifier is nonveridical if it does not entail the existence of a member of its scope. Most interesting, and problematic in my view, is the definition of antiveridicality. I give two possible analyses below. Let's start with (130)–a paraphrase of Bernardi's (2002) for this possible definition of antiveridicality.

(130) *Antiveridicality* (*Bernardi*)
A function F of type $\langle \alpha, \beta \rangle$, where α and β are propositional types, is *antiveridical* iff for all G of type α, F(G) entails* $\neg$ExClo(G).

This first definition is very strong. It requires a function to entail the negation of the existential closure of its argument. For a determiner to be antiverdical under (130), the determiner would have to entail that its restrictor is empty. As far as I know, no determiner meets this condition. *No* certainly does not. This may not be a bad thing; we haven't produced any examples of strong NPIs licensed in the restrictor of quantifiers. But, for a quantifier Q to be antiveridical this definition requires that Q entail that its scope is empty. This is the biggest problem. *No NP* does not meet this condition, though *no NP* is a paradigmatic strong NPI licenser.

So, (130) seems too strong. Let's try something else, by putting the negation inside the existential closure in the recursive definition of antiveridicality.

(131) *Antiveridicality* (*revised*)
A function F of type $\langle\alpha, \beta\rangle$, where α and β are propositional types, is *antiveridical* iff F is nonveridical and for all G of type α, F(G) entails* ExCloNot(G).

(132) If p is type t, ExCloNot(p) $= \neg$p.
If α is any other propositional type, then $\alpha = \langle\beta, \gamma\rangle$ where γ is a prop. type and ExCloNot(α) $= \exists x \in D_\beta$[ExClo(α (x))].

Under (131), to be antiveridical, a determiner should entail that there are some things not in the restrictor; a quantifier should entail that there are some things not in the scope. The determiner universal of strong conservativity makes the former impossible; see the proof in (133).

(133)
1. Assume that for all sets E, X, Y:
   If $D_E(X)(Y) = 1$, then $E - X \neq \emptyset$.
2. Further assume that D is *strongly conservative*, i.e.:
   For all sets E, X, Y such that $X, Y \subseteq E$:
   $D_E(X)(Y) = 1$ iff $D_X(X)(X \cap Y) = 1$
3. Now suppose that $D_E(A)(B) = 1$, for arbitary A, $B \subseteq E$.
4. From strong conservativity it follows that $D_A(A)(B) = 1$.
5. From assumption 1 it follows that $A - A \neq \emptyset$. This is a contradiction.
6. Thus, for all E,X,Y: $D_E(X)(Y) \neq 1$. That is, only a trivial determiner can be strongly conservative and have the property sketched in assumption 1.

Again, this may be a good thing; see the previous paragraph. The latter result concerning quantifiers, however, seems doubtful. An expression such as *not all NPs* should be a textbook example of a strong NPI licenser, but it is not. So should *few NP* on its proportional reading. However, as we have seen, judgments vary on this point. We have suggested a reason for the variation in Sect. 4.3, arguing that it derives from the heavy context dependence of *few NP*'s status as a licenser. *No NP* is antiveridical only if *no* carries an existence presupposition about its restrictor. If *no* carries such a presupposition, then the determiner *no* is veridical and can only license polarity items in its restrictor through rescuing, which, as I argued in Sect. 5, is problematic.

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References

Alonso Ovalle, Luis, and Elena Guerzoni. 2004. Double negatives, negative concord and metalinguistic negation. In *The proceedings of CLS 38.1: The main session*, ed. Mary Androni, Erin Debenport, Anne Pycha, and Keiko Yoshimura, 15–31. Chicago: Chicago Linguistic Society.
Atlas, Jay David. 1991. Topic/comment, presupposition, logical form and focus stress implicatures: The case of focal particles *only* and *also*. *Journal of Semantics* 8: 127–147.
Atlas, Jay David. 1993. The importance of being *only*: Testing the neo-Gricean versus neo-entailment paradigms. *Journal of Semantics* 10: 301–318.
Atlas, Jay David. 1996. 'Only' noun phrases, pseudo-negative generalized quantifiers, negative polarity items, and monotonicity. *Journal of Semantics* 13: 265–328.
Bernardi, Raffaela. 2002. Reasoning with polarity in categorial type logic. PhD dissertation, University of Utrecht.
Chierchia, Gennaro. 2004. Scalar implicatures, polarity phenomena, and the syntax/pragmatics interface. In *Structures and beyond*, ed. Adriana Belletti, 39–103. Oxford: Oxford University Press.
Chierchia, Gennaro. 2006. Broaden your views: Implicatures of domain widening and the "logicality" of language. *Linguistic Inquiry* 37: 535–590.
Chierchia, Gennaro in prep. *Recursive pragmatics*. Ms. Harvard University.
de Swart, Henriëtte. 1996. Meaning and use of *not…until*. *Journal of Semantics* 13: 221–263.
Deprez, Vivienne. 1999. The roots of negative concord in French and French based creoles. In *Language creation and language change: Creole, diachrony and development*, ed. Michel DeGraff, 375–428. Cambridge: MIT Press.
Diesing, Molly. 1992. *Indefinites* (*Linguistic inquiry monograph 20*). Cambridge: MIT Press.
Fox, Danny. 2000. *Economy and semantic interpretation*. Cambridge: MIT Press.
Fox, Danny. 2003. The interpretation of scalar terms: Semantics or pragmatics, or both? Paper presented at the University of Texas, Austin.
Fox, Danny. 2008. Too many alternatives: Density, symmetry, and other predicaments. In *Proceedings of SALT* 17, 89–111. Ithaca: CLC Publications.
Fox, Danny, and Martin Hackl. 2006. The universal density of measurement. *Linguistics and Philosophy* 29: 537–586.
Gajewski, Jon. 2002. L-analyticity and natural language. Ms., MIT Press.
Gajewski, Jon. 2005. Neg-raising: Presupposition and polarity. PhD dissertation, MIT Press.
Gajewski, Jon. 2007. Neg-raising and polarity. *Linguistics and Philosophy* 30: 289–328.
Giannakidou, Anastasia. 1998. *Polarity sensitivity as (non)veridical dependency*. Amsterdam: John Benjamins.
Giannakidou, Anastasia. 2002. UNTIL, aspect and negation: A novel argument for two *untils.* In *Proceedings of SALT 12*, ed. Brendan Jackson, 84–103. Ithaca: CLC Publications.
Giannakidou, Anastasia. 2004. Licensing and sensitivity in polarity items: From downward entailment to nonveridicality. In *Chicago Linguistic Society 38: Parasession on polarity and negation*, ed. Maria Andronis, Anne Pycha, and Keiko Yoshimura, 29–54. Chicago: Chicago Linguistic Society.
Giannakidou, Anastasia. 2006. *Only,* emotive factives, and the dual nature of polarity dependency. *Language* 82: 575–603.
Groenendijk, Jeroen, and Martin Stokhof. 1984. Studies in the semantics of questions and the pragmatics of answers. PhD thesis, University of Amsterdam.
Guerzoni, Elena. 2004. *Even*-NPIs in yes/no questions**.** *Natural Language Semantics* 12: 319–343.
Heim, Irene. 1984. A note on negative polarity and downward entailingness. In *Proceedings of NELS 14*, ed. Catherine Jones and Peter Sells, 98–107. Amherst: GLSA.
Heim, Irene. 1992. Presupposition projection and the semantics of attitude verbs. *Journal of Semantics* 9: 183–221.
Hoeksema, Jacob. 2006. In days, weeks, months, years, ages: A class of negative polarity items. In *Rejected papers: Feestbundel voor Ron van Zonneveld*, ed. Dicky Gilbers and Petra Hendriks, 72–85. Groningen: University of Groningen.
Homer, Vincent. 2008. Presuppositions can be disruptors too: A case against Strawson-entailment. In *Proceedings of the 27th WCCFL*, ed. Natasha Abner and Jason Bishop, 220–228. Somerville: Cascadilla Press.
Homer, Vincent. 2009. Disruption of NPI licensing: The case of presuppositions. In *Proceedings of SALT 18*, 429–446. Ithaca: CLC Publications.
Horn, Laurence R. 1989. *A natural history of negation*. Chicago: University of Chicago Press.

Horn, Laurence R. 1996. Exclusive company: *Only* and the dynamics of vertical inference. *Journal of Semantics* 13: 1–40.
Horn, Laurence R. 2002. Assertoric inertia and NPI licensing. In *Chicago Linguistic Society 38: Parasession on negation and polarity*, 55–82. Chicago: Chicago Linguistic Society.
Horn, Laurence R. To appear. Only connect: How to unpack an exclusive proposition. In *A festschrift for Jay Atlas*, ed. Martin Hackl and Rosalind Thornton. Oxford: Oxford University Press.
Kadmon, Nirit, and Fred Landman. 1993. Any. *Linguistics and Philosophy* 16: 353–422.
Karttunen, Lauri, and Stanley Peters. 1979. Conventional implicature. In *Syntax and semantics 11: Presuppositions*, ed. C. Oh and D. Dineen, 1–56. New York: Academic Press.
Krifka, Manfred. 1995. The semantics and pragmatics of polarity items. *Linguistic Analysis* 25: 1–49.
Krifka, Manfred. 1999. At least some determiners aren't determiners. In *The semantics/pragmatics interface from different points of view*, ed. K. Turner, 257–291. Amsterdam: Elsevier.
Ladusaw, William A. 1979. Polarity sensitivity as inherent scope relations. PhD dissertation, University of Texas, Austin.
Lahiri, Utpal. 1998. Focus and negative polarity in Hindi. *Natural Language Semantics* 6: 57–123.
Linebarger, Marcia. 1987. Negative polarity and grammatical representation. *Linguistics and Philosophy* 10: 325–387.
Löbner, Sebastian. 1987. Quantification as a major module of natural language semantics. In *Studies in discourse representation theory and the theory of generalized quantifiers*, ed. J. Groenendijk, M. Stokhof, and D. de Jongh, 53–85. Dordrecht: Foris.
Matsumoto, Yo. 1995. The conversational condition on Horn scales. *Linguistics and Philosophy* 18: 21–60.
Moltmann, Friederike. 1995. Exception sentences and polyadic quantification. *Linguistics and Philosophy* 18: 223–280.
Nathan, Lance. 1999. Either: Negative polarity meets focus sensitivity. Ms., Brown University.
Partee, Barbara H. 1989. Many quantifiers. In *Proceedings of ESCOL 89*, ed. Joyce Powers and Kenneth de Jong, 383–402. Columbus: The Ohio State University.
Postal, Paul. 2004. The structure of one type of American English vulgar minimizer. In *Skeptical linguistic essays*, 159–172. Oxford: Oxford University Press.
Rooth, Mats. 1985. Association with focus. PhD dissertation, University of Massachusetts, Amherst.
Rullmann, Hotze. 2003. Additive particles and polarity. *Journal of Semantics* 20: 329–401.
Schwarz, Bernhard. 2006. Covert reciprocity and Strawson-symmetry. *Snippets* 13: 9–10.
Sharvit, Yael, and Simona Herdan. 2006. Definite and non-definite superlatives and NPI licensing. *Syntax* 9: 1–31.
Strawson, P.F. 1952. *Introduction to logical theory*. London: Methuen.
van der Wouden, Ton. 1997. *Negative contexts: Collocation, polarity and multiple negation.* London: Routledge.
van Rooij, R., and K. Schulz. 2004. Exhaustive interpretation of complex sentences. *Journal of Logic, Language and Information* 13 (4): 491–519.
von Fintel, Kai. 1999. NPI-licensing, Strawson-entailment, and context-dependency. *Journal of Semantics* 16: 97–148.
von Fintel, Kai. 2004. Would you believe it? The king of France is back! Presuppositions and truth-value intuitions. In *Descriptions and beyond*, ed. Marga Reimer and Anne Bezuidenhout, 315–341. Oxford: Oxford University Press.
Yablo, Stephen. 2005. Non-catastrophic presupposition failure. Ms., MIT Press.
Zwarts, Frans. 1998. Three types of polarity. In *Plurality and quantification*, ed. F. Hamm and E. W. Hinrichs, 177–238. Dordrecht: Kluwer.