Negative Polarity and Truth Conditions

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0. Introduction

(1) The interest in studying negative polarity.
   a. Good test case for natural language semantics
   b. Distribution of morphemes regulated by
      i. meaning of surrounding environment
      ii. syntactic realization of components of meaning

(2) Polarity can help to give us a handle on questions like:
   a. What aspects of meaning is grammar sensitive to?
   b. How are those aspects of meaning tied to the structure of a sentence
   c.

(3) Themes to be addressed in these talks
   a. Polarity items that show sensitivity to different aspects of meaning
      i. Truth-conditional (narrow) meaning
      ii. Non-truth-conditional meaning (implicatures, presupposition)
   b. How truth-conditional and non-truth-conditional meaning are calculated for arbitrary constituents.
   c. The grammatical representation of meaning
      i. The distinctions between the representation of functional and lexical meaning.
      ii. Constraints on triviality at the level of semantic representation

(4) Specific topics to be addressed:
   a. The distinction between strong and weak NPIs.
   b. Grammatical approaches to presupposition and implicature.
   c. The interaction of polarity-licensing and definiteness.
   d. Extra-grammatical meaning and NPI-licensing

0.1 Basic data

Negative polarity items are expressions that show sensitivity to the 'negativity' of the environment in which they occur. I will mostly confine my comments to English, but the phenomenon is common cross-linguistically:

(5) a. English NPIs: *any*, *ever*, *yet*, *either*, *in weeks*, *a bit*…
b. Dutch NPIs: *ook maar*, *hoeven*, *bijster*, …
c. French NPIs: *quoi que ce soit*, …

(6) a. *Maria has ever been to Storrs.
b. *Maria has ever visited any towns in Connecticut.

(7) a. Maria hasn't ever been to Storrs.
b. Maria hasn't visited any towns in Connecticut.

(8) Niemand heft van de rebenbui **ook maar** iets bemerkt
No one has of the rain anything noticed (Zwarts 1998)
'No one took any notice of the rain.'

(9) Personne n' a critique **quoi que ce soit**
No one ne has criticized what that this be.SUBJ (Homer 2010)
'No one criticized anything.'

NPIs occur in a variety of licensing environments

(10) a. **No one** has visited any towns in CT.
b. Maria has **never** visited any towns in CT.

c. **Few students** have visited any towns in CT.
d. **At most ten students** have visited any towns in CT.

e. **If** there are any problems, talk to Nicholas.
f. **Before** there are any problems, register your car.

g. **Only Fred** noticed any problems.
h. Nicholas noticed the bigg**est** problem in any paper.

0.2 Licensing Conditions

(11) Downward entailing (DE) (Ladusaw 1979 et seq)
A function f is **downward entailing** if for all x, y s.t. $x \leq y$ and $f(y)=1$, $f(x) = 1$

(12) Veridicality (Giannakidou 1997 et seq)
A function f is veridical iff for all propositions p, f(p) entails p.
A function f is **non-veridical** iff f is not veridical.

For a function on sets of entities, the relevant ordering on its domain in the definition of DE is the order imposed by the subset relation ($\subseteq$).

(13) No student has visited a town in CT.
{x: x has visited Storrs} $\subseteq$ {y: y has visited a town in CT}
$\therefore$ No student has visited Storrs.

(14) Bill has not visited Storrs.
$[\![$ not $]\!]([\![$Bill has visited Storrs$]\!])$
Does not entail that Bill has visited Storrs.

These definitions give properties of denotations; we want to attribute related properties to expressions.

(15) An expression α is downward entailing iff in all models M, $[\![\alpha]\!]^{M}$ is a downward entailing function.

The definition in (15) prevents a quantifier that accidentally denotes a DE function from licensing NPIs, e.g., trivial quantifiers (cf. Ladusaw 1979). A model is simply a specification of (i) domains, the objects that language can be used to talk about, and (ii) an assignment of objects from the domain (or set theoretic objects constructed from these) to the non-logical, content words of the language.

(16) Licensing Condition
A negative polarity item must be in the scope of (c-commanded by) a downward entailing operator at logical form.

It is well known that such conditions are merely necessary, due to the phenomenon of **intervention**.

(17) a. I didn't drink any soda.
b. *I didn't drink beer and any soda.

Ultimately one wishes to explain licensing conditions, rather than stipulating them. The usual strategy is to derive distribution from the lexical semantics of the polarity item.

0.3 Weak and Strong NPIs

There are different classes of NPIs based on the class of DE operators they are licensed by. **Strong** NPIs are licensed by a proper set of the operators that license **weak** NPIs.

(18) No students smoke.
No students smoke, either.
(19) a. At most five students bought any books.
b. At most five students drink,
*At most five students smoke, either.
(20) *Hoogstens zes kinderen hebben ook maar iets bemerkt.
At most six children have anything noticed
'At most six children noticed anything.'

Zwarts 1998 gave the first compelling account of the difference between weak and strong NPIs, defining a formal property that distinguished the licensers of strong NPIs.

(21) DeMorgan's Laws
a. $\neg A \wedge \neg B \Leftrightarrow \neg(A \vee B)$
b. $\neg A \vee \neg B \Leftrightarrow \neg(A \wedge B)$

(22) Generalized de Morgan's Laws
a. $F(A) \wedge F(B) \Rightarrow F(A \vee B)$
b. $F(A \vee B) \Rightarrow F(A) \wedge F(B)$
c. $F(A) \vee F(B) \Rightarrow F(A \wedge B)$
d. $F(A \wedge B) \Rightarrow F(A) \vee F(B)$

(23) Classifying operators with (22)
a. Downward Entailing: (22)b (also, (22)c)
b. Anti-additive: (22)a and (22)b

(24) Anti-additive (AA)
A function is anti-additive iff for all A, B:
$F(A) \wedge F(B) \Leftrightarrow F(A \vee B)$

(25) An <u>expression</u> α is anti-additive iff in all models M, $[\![\alpha]\!]^M$ is an anti-additive function.

(26) a. No boy runs and no boy jumps ⇔ no boy runs or jumps
b. At most six boys run and at most six boys jump ⇏
at most six boys run or jumps

(27) a. Fewer than half the students
b. Not all the students
c. Only a few students

(28) <u>Licensing Condition</u>
A strong negative polarity item must be in the scope of (c-commanded by) an anti-additive operator at logical form.

0.4 Presuppositional Licensers

There have always been (and are still) well-known counterexamples to semantic accounts of licensing. One kind of counterexample is a licenser that is not AA or DE, but license anyway.

(29) Only Bill said anything in yesterday's class. ⇒

(30) Only Bill smokes $\nRightarrow$ Only Bill smokes cigars
Recall that {x: x smokes cigars} $\subseteq$ {y: y smokes}

(31) Sketch of the meaning of **only a is P**
a. Truth-conditions: There is no x s.t. x $\neq$ a and x is P
b. Presupposition: a is P (Horn 1969)

It is the presuppositional component of the meaning of *only* that interferes with DE-ness. A test for presupposition:

(32) A: Only Bill has turned in his homework.
B: Hey wait a minute! I had no idea Bill turned in his homework.

The results are a bit unclear. Many other proposals have been made for the presupposition of *only*:

(33) a. Some x is P
b. If some x is P, then a is P.
c. An alternative as highly ranked as a is P.

There have been a variety of responses to this problem. Ladusaw 1979 proposed ignoring 'conventional implicature' in the calculation of DE-ness. Hoeksema proposed 'weak DE-ness'. I will follow the work of von Fintel 1999.

(34) Strawson Downward Entailment
A function is **Strawson** DE iff for all x ≤ y such that f(y)=1 and f(x) is defined, f(x)=1

(35) Only Bill smokes
Bill smokes cigars
___
∴ Only Bill smokes cigars

So, von Fintel follows Ladusaw in suggesting a manner in which presuppositions of licensers get out of the way of licensing.

Other environments that license NPIs but carry interfering presuppositions:

(36) a. **If** there are any problems, talk to Nicholas.
b. **Before** there are any problems, register your car.
c. Nicholas noticed the bigg**est** problem in any paper.
d. Fred **regrets** that he said anything.

(37) Licensing Condition
A negative polarity item must be in the scope of (c-commanded by) a **Strawson** downward entailing operator at logical form.

1. Putting it together

An important question arises about these approaches is how they interact. Von Fintel proposes a new approach to entailment. Zwarts proposes a refinement of the logical properties relevant to licensing.

It is possible to define an entailment relation that applies to any two elements of a type that 'ends in t'.

(38) Generalized Entailment
a. For any x, $y \in D_t$,
$x \Rightarrow y$ iff $x \leq y$
b. For any functions f, g of type $<\sigma,\tau>$,
$f \Rightarrow g$ iff for all $x \in D_\sigma$, $f(x) \Rightarrow g(x)$

So, for example, one function f of type <e,t> entails another g just in case f is the characteristic function of a set that is a subset of the set characterized by g.

(39) ⟦ *linguistics student* ⟧ ⊨ ⟦ *student* ⟧

As before:

(40) An expression α entails another expression β iff in all models M,
$[\![\alpha]\!]^M \Rightarrow [\![\beta]\!]^M$

To generalize Strawson Entailment beyond the propositional case, we must build in the statement that the consequent is defined (and in fact the antecedent).

(41) Generalized Strawson Entailment

a. For any x, $y \in D_t$,

$x \Rightarrow_S y$ iff $x \leq y$

b. For any (partial) functions f, g of type <σ,τ>,

$f \Rightarrow_S g$ iff for all $x \in D_\sigma$ s.t. $x \in dom(f)$ & $x \in dom(g)$, $f(x) \Rightarrow_S g(x)$

(42) Strawson Anti-Additivity

A function F is Strawson Anti-Additive iff for all A, B

$F(A) \wedge F(B) \Leftrightarrow_S F(A \vee B)$

(43) $F(A) \wedge F(B) \Rightarrow_S F(A \vee B)$

Assume: $A \vee B \in dom(F)$

(44) $F(A) \wedge F(B) \Rightarrow_S F(A \vee B)$

Assume: $A \in dom(F)$ and $B \in dom(F)$[1]

(45) Licensing Condition (?)

A strong negative polarity item must be in the scope of (c-commanded by) a Strawson anti-additive operator at logical form.

(46) Only Bill smokes
Only Bill drinks
(Bill smokes or drinks)
∴ Only Bill smokes or drinks

Only Bill smokes or drinks
(Bill smokes
Bill drinks)
∴ Only Bill smokes and only Bill drinks

(47) a. ⟦**Only Bill**⟧ is Strawson Anti-additive

b. Superlatives, conditionals, *regret*, *before*-clauses are AA as well.

[1] This assumes that the presupposition of a conjunction is the presupposition

QUESTION: Is the licensing condition in (45) the correct one for strong negative polarity items?

(48) Crucial data

a. Only Bill went to Paris.

*Only Bill went to Storrs, either.

b. *Only $Bill_i$ arrived until his_i birthday.

c. *Only Bill has visited Mary in weeks.

(49) a. Bill regretted that he went to Paris.

*He regretted that he went to Storrs, either.

b. *Bill regretted that he_i arrived until his_i birthday.

c. *Bill regretted that he had visited Mary in weeks.

(50) a. Bill will be happy, if he goes to Storrs.

*Bill will be happy, if he goes to Paris, either.

b. *Bill will be happy if he_i arrives until his_i birthday.

c. *Bill will be happy if he has visited Mary in week.

Evidently not: all the data suggest that merely Strawson anti-additive operators never actually license strong NPIs. [Note: all Strawson AA operators are Strawson DE – in the same way as in the non-Strawson case.

Apparently then, (45) is not the correct licensing condition for strong NPIs in English. So now, we are in an awkward position: we must use Strawson entailment in the licensing condition for weak NPIs and standard, presupposition-insensitive entailment for the licensing condition for strong NPIs.

We have two separate parameters to set: DE vs. AA and Strawson vs. standard entailment. This would seem to predict four different kinds of polarity items.

(51) Licenser Types

not, **never**, **no**, **without**

only NP, **if**, **-est** **at most 5** NP, **few** NP

merely strawson merely DE operators (accidental gap?)

(52)

	Standard	Strawson
DE	?	weak
AA	strong	?

As far as I know this typology does not fill out, at least not in English.

(53) <u>Predicted NPI types:</u>
a. [+DE, +Standard]: licensed by *at most 5 students*, but not by *only Al*
b. [+AA, +Strawson]: licensed by *only Al*, but not by *at most 5 students*

[Anyone know of items like these? Let me know!]

What then is the right theory of the weak strong distinction in English? I will argue that we need to assimilate the DE/AA parameter to the presuppositional case.

2. A new theory of the weak/strong distinction

Two sources of inspiration: Chierchia's 2004 work on the interference of implicatures in NPI licensing. Krifka's reanalysis of the Zwart's typology in terms of scale structure.

2.1 Chierchia on implicatures

Chierchia 2004 argues that implicatures are calculated recursively in parallel with the regular recursive calculation of truth-conditions.

(54) John thinks that some of his students are waiting for him.

(55) a. Some of his students are waiting for him.
b. Scalar implicature: not all of his students are waiting for him.

(56) Scale: <every, most, … , a few, some>
←Stronger—

(57) John thinks that not all his students are waiting for him.

[I should note that the idea that such sentences argue in favor of grammatical mechanisms of implicature calculation is quite controversial.]

Chierchia suggested that the calculation of an implicature in a structure might interfere with NPI licensing. Why would this be? [Chierchia assigns to each constituent a plain meaning and a strong meaning. The strong meaning is the plain meaning plus implicatures.]

(58) a. $[\![$ **some student** $]\!]$ = $\lambda A.\{x: x \text{ is a student}\} \cap A \neq \varnothing$ (plain)
b. $[\![$ **some student** $]\!]_S$ = $\lambda A. \{x: x \text{ is a student}\} \cap A \neq \varnothing$ & $\{x: x \text{ is a student}\} \not\subseteq A$ (strong)

Notice how the incorporation of implicatures into the strengthened meaning affects montonicity. If some student smokes cigars, then some student smokes. But if some but not all students smoke cigars,we cannot be sure that some but not all students smoke. They may all.

(59) a. $[\![$ **some student** $]\!]$ is an upward entailing (UE) function.
b. $[\![$ **some student** $]\!]_S$ is not an upward entailing (UE) function.

The implications for NPI licensing are obvious. Any scalar operator that is DE but not highest on its scale in terms of strength will give raise to implicatures. These implicatures will break its monotonicity.

(60) Negative scale: <no, few, … , not many, not every>

←Stronger—

(61) a. $[\![$ **few students** $]\!] = \lambda A.\{x: x \text{ is a student}\} \cap A < n[n \text{ is small}]$

b. $[\![$ **few students** $]\!]_S = \lambda A.\{x: x \text{ is a student}\} \cap A < n \;\&$

$.\{x: x \text{ is a student}\} \cap A \neq \varnothing$

But we know that merely DE function do license NPIs, how might these implicatures be relevant to NPI licensing?

Well, we also know that not all DE functions license all NPIs. Strong NPIs are not licensed by

2.2 Krifka on strong NPIs

Krifka 1995 endorses a different view of strong NPIs from Zwarts's – one more consonant with the one that I adopt.

Krifka introduced the idea later exploited in Chierchia 2004 that polarity items such as *any* introduce alternatives, in particular subdomain alternatives. So, for example, *any dog* introduces alternative indefinite quantifying over subdomains of dogs, e.g., toy dogs, sport dogs…

These alternatives are then exploited by covert pragmatic operators **Scalar Assertion** and **Strong Assertion** that have meanings similar to 'only' and 'even'.

Krifka suggested that strong NPIs differ from others in being **emphatic**. He then proposed that emphatic NPIs are most at home in extreme environments. Hence, a strong NPI prefers licensers that are the ends of scales.

2.3 A proposed synthesis

I have proposed a synthesis of Chierchia's and Krifka's ideas that I believe explains the distribution of strong NPIs and resolves our dilemma about the predicted classes of NPIs.

Point 1: Items that occupy the ends of scales do not give rise to scalar implicatures.

(62) a. <never, rarely, … , not always>
b. <no, few, … , not every>
c. <not>

Since there are no stronger items on the scales than these, there are no alternatives that can be excluded.

(63) For any item α that occupies the end of a scale:
$[\![\alpha]\!] = [\![\alpha]\!]_S$

Point 2: It is plausible to conjecture that the endpoints of negative scales are anti-additive.

This conjecture links the works of Chierchia and Krifka to the work Zwarts. Now we can state a necessary condition on the licensing of NPIs.

(64) Hypothesis
a. A **weak** NPI must be c-commanded by an operator α such that in all models M, $[\![\alpha]\!]^M$ is a downward entailing function.
b. A **strong** NPI must be c-commanded by an operator α such that in all models M, $[\![\alpha]\!]_S^M$ is a downward entailing function.

Given this condition, a strong NPI must be c-commanded by an operator whose strong meaning denotes a DE function.

(65) a. Only the endpoints of negative scales do not trigger implicatures.
b. The strong meanings of negative operators that trigger implicatures are not DE.
c. Only the end points of negative scales license strong NPIs.

There is one aspect of this analysis worth commenting on now. It is a property we inherit from Chierchia. The licensing conditions for strong NPIs are given in terms of implicatures. Implicatures can disappear in the right context:

(66) I ate some of the cookies. In fact, I ate them all.

Crucially the licensing condition is not sensitive to context in this way. Items low on the negative scale do not become good licensers, just because their implicature is canceled in context. [Though see discussion of **few** below]

Integrating Presupposition

This is not the whole story. This condition only tells us what to do with implicatures. We must think also of how to incorporate presuppositions.

There are many operators we can use to convert presuppositions into truth conditions. One such operator is Beaver and Krahmer's Floating A in a trivalent logic.

(67)

p	Ap
1	1
0	0
#	0

When this operator attaches to a proposition p, it creates a new proposition that is true just when p is true and defined and false otherwise. It is straightforward to define a type-general version:

(68) a. A(1) =1, A(0)=0 and A(#)=0
For all $x \in D_e$, A(x)=x
b. For any function of type $<\sigma,\tau>$,
$$A(F) = \lambda x \in D_\sigma .A(F(x))$$

The effect of the operator is to make all presuppositions truth-conditional:

(69) a. ⟦ **Only Bill** ⟧ = $\lambda f: f \in D_e$ & f(b)=1. $\neg\exists y[\, y \neq b$ & F(y)=1]
b. A⟦ **Only Bill** ⟧ = $\lambda f \in D_e$. f(b)=1 & $\neg\exists y[\, y \neq b$ & F(y)=1]

The reason to do this is merely that we no longer need to worry about how to define entailment – we can use a traditional notion.

Putting the pieces together, we see that an alternative theory to using the DE/AA theory to differentiate strong and weak NPIs is to differentiate them by means of sensitivity to non-truthconditional meaning.

We can now supplement the licensing conditions we had proposed above:

(70) Hypothesis (revised)

a. A **weak** NPI must be c-commanded by an operator α such that in all models M, $[\![\alpha]\!]^{M}_{TC}$ is a downward entailing function.

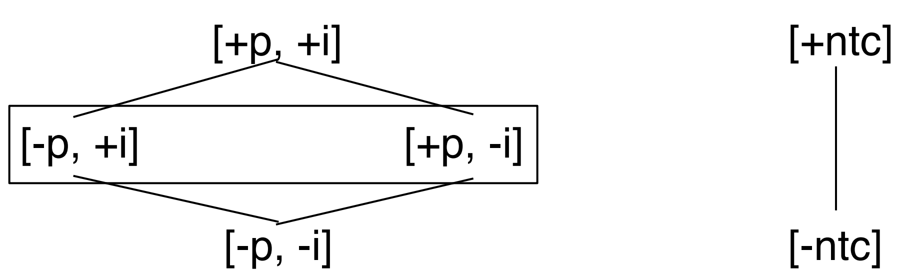
b. A **strong** NPI must be c-commanded by an operator α such that in all models M, $\boxed{A[\![\alpha]\!]^{M}_{S}}$ is a downward entailing function.

Let's take stock at this point. First, let's remind ourselves of the quandary we faced. Weak NPIs appear to be require DE – not necessarily AA – licensers and to ignore presuppositions. Strong NPIs appeared to require AA licensers and to be allergic to presuppositions. We could not see how the two things went together. Also we appeared to predict kinds of NPIs that don't exist.

How are we doing now? We have suggested that the DE/AA distinction is an illusion and boils down to sensitivity to implicatures. This allows us to see how the two things go together. Weak NPIs only see truth conditions. Strong NPIs are sensitive to all grammatically determined meaning.

Do we also predict kinds of NPIs that do not exist? Possibly.

(71)



I have treated scalar implicatures and presupposition as distinct phenomena with distinct grammatical representations. Hence, it is possible that an NPI could be sensitive to one but not the other. One way around this would be to adopt a theory that treats the calculation of implicatures and presupposition the same, as in Chemla's 20?? Similarity Theory.

At minimum we have provided a potential unification.

Advantage
Notice now that all NPIs, weak and strong alike, are looking for downward entailing licensers. They just happen to look for that property at different levels of meaning.

This could be important for advancing the study of NPI semantics. Ultimately we want to push past licensing conditions and attempt to explain the distribution of NPIs. The most common strategy for doing this is to derive distribution from lexical semantics.

Widening & Strengthening Kadmon & Landman (1993) – can we apply this to strong NPIs?

2.4 A note on veridicality based accounts

Giannakidou 2006 proposes that strong NPIs are sensitive to antiveridicality a stronger notion than non-veridicality.

(72) Veridicality (Giannakidou 1997 et seq)
A function f is veridical iff for all propositions p, f(p) entails p.
A function f is **non-veridical** iff f is not veridical.

(73) Antiveridicality (Giannakidou 1997 et seq)
A function f is antiveridical iff for all propositions p, f(p) entails ~p.

To really evaluate the viability of veridicality here it is necessary to generalize the definition. Here we follow in spirit Bernardi 2002. The main difficulty in generalizing is that when we look at non-propositional operators we need to know what the entailment relation is like between functions of different types.

(74) Conjoinable types

a. t is a propositional type

b. if α is a propositional type and β is any type, $<\beta,\alpha>$ is a propositional type.

(75) A function F of type $<t,t>$ is <u>veridical</u> iff for all p of type t, F(p) entails p.

(76) A function F of type $<\alpha,\beta>$, where α and β are propositional types, is <u>veridical</u> iff for all G of type α, F(G) entails* ExClo(G)

(77) Recursive Definition of Existential Closure (ExClo)

a. If p is type t, ExClo(p) = p

b. If α is any other propositional type, then $\alpha = <\beta,\gamma>$ where γ is a prop. type and $ExClo(\alpha) = \exists x \in D_\beta[ExClo(\alpha(x))]$

(78) For any F, ⟦*some*⟧(F) is veridical because for any G: *some Fs are Gs* entails that there are Fs.

(79) 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 $<\mu,\nu>$ where ν is conjoinable,

α entails* β iff for all γ of type μ, $\alpha(\gamma)$ entails* $\beta(\gamma)$

If the type of α is $<\mu,\nu>$, where ν ends in the type of β,

then α entails* β iff for all γ of type μ, $\alpha(\gamma)$ entails* β

(80) A type μ ends in type ν, if

a. $\mu = \nu$, or

b. $\mu = <\beta,\gamma>$ where γ ends in ν

(81) A function F of type $<\alpha,\beta>$, where α and β are propositional types, is <u>antiveridical</u> iff for all G of type α, F(G) entails* ¬ExClo(G)

Consider what it would take for a generalized quantifier Q (a function of type $<<e,t>,t>$) to meet the condition of being antiveridical. It would have to be that for every predicate P (function of type $<e,t>$), Q(P) entails ¬ExClo(P). The existential closure of a predicate like **laugh** would be the proposition that some individual laughs. So the negation of that is the proposition that no individuals laughs.

Thus an antiveridical quantifier Q must entail that is predicate argument denotes the empty set. There is no such quantifier.

(82) $[\![$ **no student** $]\!]$(P) does not entail that P = ∅

Is there a fall back position?

(83) A function F of type <α,β>, 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)

(84) If p is type t, ExCloNot(p) = ¬p
If α is any other propositional type, then α = <β,γ> where γ is a prop. type and ExCloNot(α) = $\exists x \in D_\beta$[ExClo(α(x))]

This position seems too weak: **not every** would qualify as a strong NPI licenser – indeed it is unclear if it licenses NPIs at all. Similarly for expressions like **exactly 9 of 10**.

I think the only hope for antiveridicality would be to suggest that all licensers of strong NPIs are decomposed into negation (antiveridical) and something else. This theory would be little different from Klima 1964.

2.5 Section Summary

A more appealing account of the distinction between strong and weak NPIs in English can be derived from looking at the way that (non-)truth conditional meaning factors into licensing. The DE/AA account of Zwarts fails to explain the connection between the two logical conditions and the two different notions of entailment. The TC account derives a better typology.

3. Intervention

Unfortunately as appealing as this story is, it faces some difficulty. The main difficulty is that there is evidence that in fact all NPIs are sensitive to non-truthconditional meaning – even weak NPIs. This evidence comes from intervention effects.

Clearest cases (Linebarger 1987):

(85) Maria didn't drink any liquor.
Maria didn't eat steak <u>or</u> drink any liquor.
*Maria didn't eat steak <u>and</u> drink any liquor.

(86) No professor gave Maria any books.
No professor$_i$ gave a student of hers$_i$ any books.
*No professor$_i$ gave <u>every</u> student of hers$_i$ any books.

(87) Chris didn't read Moby Dick because he had to.
*Chris didn't read any books because he had to ~~read a book~~
Chris didn't read any books because he hates reading.
[But see Hsieh 2012 for a different view on *because*.]

What Linebarger showed most conclusively was that licensing conditions like Ladusaw's were at most necessary conditions. Being in the scope of a DE operator is not enough.

Linebarger's (1987) account:

(88) <u>Immediate Scope Constraint</u>
A negative polarity item must be in the immediate scope of it licenser. (No logical operator may intervene.)

Linebarger's account was ingenious but depends on the assumption that everything that occurs between an NPI and its licenser is not an operator. For indefinites and disjunction this is possible if one follows Heim 1981.
(89) No professor gave many of her students any books.

Also it is unclear why the intervention of other logical operators matters.

3.1 Chiechia 2004

Chierchia 2004, building on Krifka 1995 offers an account that (i) aims to be compatible with theories in which indefinites are logical operators and (ii) explains why intervention disrupts licensing.

1. Chierchia notes that interveners tend to be elements that occupy the end of scales, as their strongest elements.

(90) a. <every, most, … , a few, some>
←Stronger—
b. <and, or>
←Stronger—
c. Chierchia analyzes *because* as a special kind of **and**.

2. Strong end elements do not give rise to implicatures when unembedded – they have no stronger alternatives.

(91) Every student smokes
No scalar quantity implicature.

3. When embedded in environments that reverse entailments, strong-end elements produce the weakest statement – triggering an implicatures. Chierchia calls these indirect implicatures.

(92) Maria didn't buy every book.
Indirect implicature: Maria did buy some book.

(93) Fred doesn't drink AND smoke.
Indirect implicature: Fred does drink OR smoke.

Environments that reverse entailments are DE.

4. When such implicatures are incorporated into the meaning of a constituent they block DE inferences.

(94) a. No professor gave every student a book.
b. No professor gave every student a book and
some professor gave some student a book.
c. No professor gave every student a semantics book and
some professor gave some student a semantics book.

Notice that when the implicature is taken into account, (94)b, downward inference are blocked. (94)c doesn't follow from (94)b – the fact that some professor gave some student a book does not imply that some professor gave some student a semantics book.

But of course, these NPIs are still c-commanded by DE operators. So, to make implicatures interfere, we need a different environment-based approach to licensing (Heim 1984, Zwarts 1996, Gajewski 2005).

(95) An occurrence α of an NPI is licensed only if it is contained in a constituent β such that for some variable σ_i of the same type of α:

$\lambda x. [\![\beta [\alpha/\sigma_i]]\!]^{a[x\backslash i]}$ is a downward entailing function.

where $\beta [\alpha/\sigma_i]$ is the constituent β modified so as to replace α with σ_i.

This is of course not quite enough, since it does not yet incorporate implicatures. Here is the necessary amendment – strong meaning:

(96) $\lambda x. [\![\beta [\alpha/\sigma_i]]\!]_S^{a[x\backslash i]}$ is a downward entailing function.

So, now, all implicature related meaning is taken into account in the licensing of negative polarity items. As we know this can't be the whole story – we will return to a synthesis.

3.2 Homer 2009

Homer extends Chierchia's observations and ideas to the case of presuppositions as interveners. It is easy to find examples of presuppositional items interfering with DE inferences.

(97) Bill doesn't think that Maria bought anything.
*Bill doesn't think that Maria too bought anything.

(98) *Bill doesn't think it's Maria that bought anything.
*Bill doesn't know that Maria bought anything.

(99) Presupposition
Bill thinks that some one ≠ Maria bought something

(100) A $\lambda x[\![$ not Bill think that Maria too bought $\sigma_i]\!]^{[i \rightarrow x]}=$
λx. Bill doesn't think Maria bought x &
Bill does think some one ≠ Maria bought x

Once again the incorporated non-truth conditional meaning interferes with downward-entailing inferences.

(101) a. Bill thinks that some one ≠ Maria bought a book.
b. Bill thinks that some one ≠ Maria bought a semantics book.

(102) Environment-based licensing
An occurrence α of an NPI is licensed only if it is contained in a constituent β such that for some variable σ_i of the same type of α:

$A(\lambda x.[\![\beta [\alpha/\sigma_i]]\!]_S^{a[x\backslash i]})$ is a downward entailing function.

But once again – this fails to incorporate a strong/weak distinction. In some ways that is good. Both strong and weak quantifiers show intervention.

(103) a. Bill likes to drink wine.
b. He likes to drink beer too and eat meat.

(104) **and** intervening in licensing of **either**
a. Bill doesn't like to drink wine.
b. *He doesn't like to drink beer either and eat meat.

c. He doesn't like to drink beer either or eat meat.

(105) **too** intervening in licensing of **until**
a. I don't think Bill arrived until his birthday.
b. *I don't think Bill too arrived until his birthday.

And yet, we need to fix the non-intervention cases.

3.3 Licensing: Operators vs. Environments

Approaches to NPI licensing generally choose one over the other: either NPIs are licensed by a c-commanding operator, or they are licensed by the properties of the environments that contain them.

It appears now that we need to make reference to both.

(106) Does non-truth conditional meaning matter?
a. Strong NPIs
i. Licenser: yes
ii. Environment: yes
b. Weak NPIs
i. Licenser: **no**
ii. Environment: yes

An additional wrinkle that needs to be incorporated into this picture: implicatures generated by items contained in licensers.

(107) a. No student that drinks and smokes arrived until his birthday.
b. No student that runs passed.
No student that drinks and smokes passed either.
c. No student that drinks and smokes has visited Maria in weeks.

These are all good. But consider the potential interference of the scalar item contained in the subject.

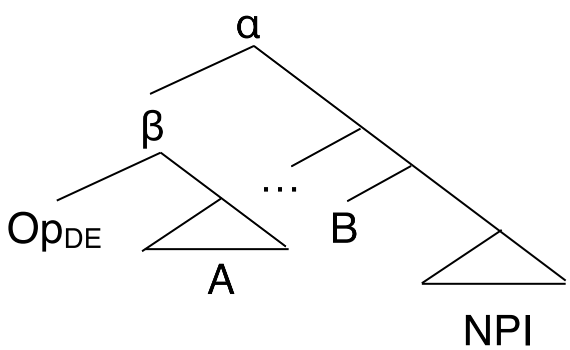
(108) a. No student that smokes and drinks passed.
b. A student that smokes or drinks passed.

c. A student that smokes or drinks got an A+.

(109) Every student drinks.
No student that smokes too arrived until his birthday.
No student that smokes too has visited Maria in weeks.

These data suggest the following generalization

(110)



	Strong	Weak
Op	✔	✖
A	✖	✖
B	✔	✔

An important additional observation: items that are c-commanded by the NPI do not intervene.

(111) a. No professor gave any student every book.
b. No professor gave any student [also Moby Dick].

Tentative generalization:

(112) To intervene for licensing between NPI α and licenser β, an expression must c-command α and be c-commanded by β.

This generalization suggest that intervention must be <u>syntactic</u> after all.

3.4 Chierchia 2012 on intervention

(113) a.Eliminate ‘Licensing generalizations’
b. The distribution of NPIs determined by their lexical
c. Semantics should explain functional, communicative role of NPIs

(114) Key points of Chierchia’s theory

a. Polarity sensitive items obligatorily activate a set of alternatives
b. Polarity sensitive items are the weakest element among these sets
c. Items that obligatorily activate alternatives must undergo exhaustification
d. The connection between PSI and exhaustifier can be seen as a form of syntactic agreement.
e. The distribution of PSIs derives from their lexical semantics, the alternatives they activate and the kind of exhaustification they undergo.
f. There are strict limits on the possible variation in alternatives and exhaustification
g. The functional basis of the system is emphasis

The talk of ‘obligatory’ activation of alternatives is meant to contrast PSIs with garden variety scalar terms like *or* or *some*, which only optionally invoke alternatives. When they activate them, scalar implicatures arise; when they do not, the implicatures are ‘canceled’.

Chierchia assumes that there are two covert exhaustifiers: E and O. He argues that the existence of both is independently motivated.

(115)a. Who came to the party? Sue and Fred did.
“Only Sue and Fred did”
b. How was the party last night? It was a great success. My ex came! Imagine!
“Even my ex came.”

(Also recall Krifka’s 1995 Strong and Scalar Assert.) Here are the relevant definitions.

(116) $O_{ALT}(p) = p \wedge \forall q \in C[\, q \rightarrow p \subseteq q]$, where $g(C) \subseteq ||\phi||^{ALT}$, and $g(C)$ contains at least a member of $||\phi||^{ALT\text{-}\sigma}$ and the strongest members of $||\phi||^{ALT\text{-}D}$, if any is active.

(117) $E_{ALT}(p) = p \wedge \forall q \in ALT[\, p <_{\mu} q]$ Even-exhaustification

where ‘$p <_\mu q$’ says that p is less likely than q with respect to some contextually relevant probability measure μ.

An important point to remember:

(118) If p entails q, then for any probability measure μ, $p \leq_\mu q$

Quantificational determiners all carry a contextual restriction on their domain. This domain is a property (a function from worlds to sets), but for most purposes it will suffice to think of them as sets.

(119) a. $Some_D$ student doesn’t know me.
b. $\exists x[D_w(x) \wedge student_w(x) \wedge \neg know_w (x, me)]$
c. $\exists x{\in}D[student_w(x) \wedge \neg know_w (x, me)]$

Plain NPIs – how they come about and relate to emphatic NPIs

Plain NPIs like *any* must occur in DE environments. But why? NPIs seems to trigger ‘widening and strengthening’. But widening is not always observed. Chierchia will attempt to capture both – in so far as they are true – with exhaustification.

[40] a. i. I don’t have $[_{NP/D'}$eggs]
ii. I don’t have any_D eggs
b. i. O_C $\neg[\exists x{\in}D[egg_w(x) \wedge have_w (I,x)]$
ii. $C = \{\neg[\exists x{\in}D'[egg_w(x) \wedge have_w (I,x)]: D' \subseteq D\}$

Rooth’s 1992 anaphoric condition on contrastive focus: the antecedent must be a member of the alternative set distinct from the value assumed by the anaphor. This accounts for the domain widening effect under contrast.

When there is no contrast, *any* still activates subdomains but its domain may be set however context demands.

Any-type NPIs differ from **even-some** NPIs in how their alternative sets are defined: $\angle_\mu$ is replaced with $\subseteq$.

(42) a. $[\![\text{any}]\!] = [\![\text{some}]\!] = \lambda P \lambda Q \exists x \in D[P_w(x) \wedge Q_w(x)]$
b. $[\![\text{any}]\!]^{ALT} = \{\text{some}_{D'}: D' \subseteq D\}$ [Loss of emphasis]

This creates a set of alternatives that is not linearly ordered, therefore O is required. [Chierchia's principle of Optimal Fit]

(120) *John has any eggs

(121) $O_C([\exists x \in D[\text{egg}_w(x) \wedge \text{have}_w(I,x)]) = \bot$, where $C = \{a, b, c\}$

But…

(122) $O_C(\neg \exists x \in D[\text{egg}_w(x) \wedge \text{have}_w(I,x)) = \neg \exists x \in D[\text{egg}_w(x) \wedge \text{have}_w(I,x)]$

"The basic idea is that there is a simple difference between the alternatives of *some* and those of *any*: the obligatoriness of the latter."

(123) $\text{some}_{[\pm \sigma/ \pm D]}$ optionally active scalar and D-alternatives
$\text{even-some}_{[+\sigma/+D]}$ obligatorily active scalar and domain alternatives
D-alternatives ordered by '$\angle_\mu$' [→ E-exhaustification]
$\text{any}_{[+\sigma/+D]}$ obligatorily active scalar and D-alternatives
D-alternatives ordered by '$\subseteq$' [→ O-exhaustification]

(124) Chierchia's Strong exhaustification
$$O^S_C [\phi_{w, [+\mathbf{D}]}] = \forall p \in C/\mathbf{D}[^\pi p_w \wedge O_\sigma [p_w] \rightarrow \lambda w [^\pi \phi_{w, [+\mathbf{D}]} \wedge O_\sigma[\phi_{w, [+\mathbf{D}]}] \subseteq \lambda w [^\pi p_w \wedge O_\sigma[p_w]]$$

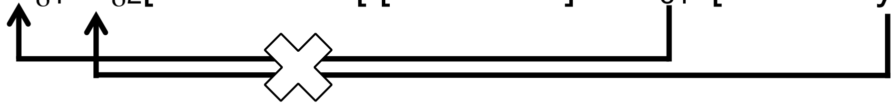
Within this theory, scalar implicatures are also factored into the meaning through covert exhaustification operators.

(125) Bill ate some cookies
O_C [Bill ate $\text{some}_{+\sigma}$ cookies]
$C = \{Q(\lambda x[\text{cookie}_w(x)], \lambda x.[\text{ate}_w(\text{Bill},x)])$: Q is on **some**'s scale$\}$

(126) a. Maria didn't eat steak and drink any liquor

b. $O_{\sigma2}$ $O_{\sigma1}$[Maria not [[eat steak] and$_{\sigma1}$ [drink any$_{\sigma2}$ liquor]]

c. $O_{\sigma1}$ $O_{\sigma2}$[Maria not [[eat steak] and$_{\sigma1}$ [drink any$_{\sigma2}$ liquor]]



When the scalar term does not c-command, the principles of agreement do not determine an order between the exhaustifiers.

(127) a. No$_{\sigma}$ one who smokes and$_{\sigma}$ drinks has seen Mary in weeks$_{\sigma}$
b. Someone who smokes or drinks (but not both) has seen Mary over the past weeks
c. $O_{\sigma1}$ [No$_{\sigma1}$ one who smokes and$_{\sigma2}$ drinks has seen Mary in weeks]
d. $O_{\sigma2}$ $O^{S}_{\sigma1,\,\mathbf{D}}$ [No$_{\sigma1}$one who smokes and$_{\sigma2}$drinks has seen Mary in wks$_{+\mathbf{D}}$]

4. NPIs in definite descriptions

An interesting an challenging case for this theory is the presence of negative polarity items in definite descriptions. Inspired by Frege and Sharvy (1980):

(128) a. $[\![\textbf{the}]\!] = \lambda P{:}\,\exists x \forall y[\textsc{max}(P)(y) \leftrightarrow x = y].\ \iota x.\textsc{max}(P)(x)$
b. $\textsc{max}(P) \coloneqq \lambda x.P(x)\ \&\ \neg\exists y[P(y)\ \&\ x < y]$

The expression 'ιx' means 'the unique x'. The relation '<' presupposes the existence of a relevant part-whole relation in the denotation domain of individuals.

Observations about NPIs

Lahiri 1998, discussing Hindi, and Guerzoni and Sharvit 2007 observe that weak NPIs such as **ever** and **any** are not licensed in singular definite descriptions, but are licensed in plural definites.

(129) a. *Bill met the student who had published anything.

b. (?)Bill met the students who had published anything.

Neither singular nor plural definites license strong NPIs:

(130) a. *Bill met the student who$_i$ arrived until his$_i$ birthday.
b. *Bill met the students who$_i$ arrived until their$_i$ birthdays.
c. *Bill met the student who$_i$ had visited Maria in weeks.
d. *Bill met the students who$_i$ had visited Maria in weeks.

Lahiri's 1998 analysis

(131) The student smokes
Presupposition: there exists a unique salient student
Assertion: the unique student smokes

(132) Singular definites are Strawson DE
The unique salient student smokes
There exists a unique salient semantics student
∴ The unique salient semantics student smokes

(133) Singular definites are Strawson UE
The unique salient semantics student smokes
There exists a unique salient student
∴ The unique salient student smokes

(134) Plural definites are Strawson DE
The maximal plurality of students smokes
There exists a maximal plurality of semantics students
∴ The maximal plurality of semantics students smokes

(135) Plural definites are NOT Strawson UE
The maximal plurality of semantics students smokes
There exists a maximal plurality of students
∴ The maximal plurality of students smokes

(136) New licensing condition
An NPI must occur in an environment α such that α is Strawson DE and α is not Strawson UE.

This analysis is not available to us for two reasons. Strawson entailment is no longer part of our theory. Instead, we appeal to a purely truth-conditional component of meaning.

But this presents a new problem. When the domain condition of (137) fails, the value description does not denote.

(137) a. $[\![\textbf{the}]\!] = \lambda P{:}\, \exists x \forall y[\text{MAX}(P)(y) \leftrightarrow x = y].\ \iota x.\text{MAX}(P)(x)$

We will have to fix this. Before doing so, we need to consider what is doing the licensing.

NPIs and distributivity

Note that in the examples above (134) the downward entailing inferences appear to derive from the distributivity of the main predicate.

(138) For any plurality x,
x smokes iff for all y s.t. $y<x$, y smokes

Of course not all predicates of pluralities are distributive. Some are collective.

(139) The students are numerous.
outnumber the professors.
are a team.

(140) Therefore…
#The semantics students are numerous.
#The semantics students outnumber the professors.
#The semantics students are a team.

The question then is whether the distributivity/collectivity of the main predicate has any effect on the licensing of NPIs.

(141) a. The students that have ever been to Paris smoke.
b. The students that have ever been to Paris are numerous.
c. The students that have ever been to Paris outnumber the profs.
d. The students that have ever been to Paris are a team.

The informants that I have asked about these sentences do not find significant differences among them. It should be said, though, that most do not find them perfect, either.

Anti-distributivity?

(142) *The students who together lifted any pianos are tired.
(Hsieh 2012)

(143) The propositions that together entail any contradictions are inconsistent.

This is puzzling, since these predicates do not create even a Strawson DE environment.

(144) The students are numerous.
There is a maximal plurality of semantics students.
∴ The semantics students are numerous.

Given the lack of connection between the licensing of NPIs and entailments at the propositional level, we need to look elsewhere.

Despite the lack of entailment, there is an important relation that holds between the two descriptions, whenever there are semantics students.

(145) $[\![$ the semantics students $]\!] < [\![$ the students $]\!]$

This holds regardless of the distributivity of the predicate that applies to the description. We can see this part-whole relation as a variety of entailment, and broaden our view of the relation and its role in licensing.

(146) Generalized Entailment (Non-Boolean)

a. For any x, y$\in D_t$,
 $x \Rightarrow y$ iff $x \leq y$

b. For any x, y$\in D_e$,
 $x \Rightarrow y$ iff $y < x$

b. For any functions f, g of type $<\sigma,\tau>$,
 $f \Rightarrow g$ iff for all $x \in D_\sigma$, $f(x) \Rightarrow g(x)$

(See Guerzoni and Sharvit 2007 fn for a similar suggestion.)
If we adopt such a broadened view of entailment we capture the independence of NPI licensing and distributivity in definites.

The definedness issue

(147) a. $[\![$ **the** $]\!] = \lambda P{:}\sqcup P \in P.\ \sqcup P$ (cp. Landman 2004)
b. $\sqcup P$ = the supremum of P in D_e

An individual x is the supremum of set S in domain D iff x is the least element in D that is greater than every element of S. Note the x may not be in S.

(148) x is supremum of S in $D_<$ iff for all $y \in S$, $y<x$ and for all z s.t. for all $y \in S$, $y<z$, $x<z$

I assume that the domain of individuals is made up of a set of atoms closed under sum formation. Every subset of the domain D_e will always have a supremum.

If we set aside the presupposition, it follows that if P is a subset of Q, then $\sqcup P < \sqcup Q$. Hence, $[\![$ **the** $]\!]$ comes out downward entailing – without resorting to Strawson entailment.

The issue now is that we must block licensing in singular definite descriptions.

(149) a. All nouns come out of the lexicon pluralized
b. the plural morpheme is vacuous (Sauerland 2003)
c. the singular restricts noun meanings to atoms

I need to use a completely defined function for the value description of the definite article, that does not automatically yield DE-ness. This will do the trick.

(150) $\text{Max}(P) = \sqcup P \quad \text{if } \sqcup P \in P$
$= \mathbf{0} \quad \text{otherwise}$

To complete the analysis we must remember that we are not working in a licenser-base system – but in an environment based one. So, what we must compare are the functions below, which are derived from the environment definite article + number feature.

(151) a. $\lambda P.\ [\![\textbf{the}]\!]([\![\text{PL}]\!](P))$
b. $\lambda P.\ [\![\textbf{the}]\!]([\![\text{SG}]\!](P))$

Suppose the presence of plural morphology always closes a noun extension under sum formation and that singular morphology restricts a noun extension to the atoms in its denotation.

(152) a. $\lambda P.\ \text{Max}(^*P)$
b. $\lambda P.\ \text{Max}(AT \cap P)$

Since for every set P, $\sqcup^*P \in {}^*P$, the function in (152)a is downward entailing. So, the definite article + plural is DE. On the other hand, if a set P contains more than one atom, then $AT \cap P$ will map to **0** – but P will have subsets that contain only one atom and hence map onto a singleton set. Every singleton set is above **0** in the domain and hence the definite article + singular is <u>not</u> DE.

The last piece of the puzzle is to guarantee that A(151)a is not DE – it doesn't appear to license strong NPIs.

(153) $[\![\textbf{the}]\!] = \lambda P{:}\ \sqcup{*}P \in {*}P\ \&\ \sqcup{*}P \neq \mathbf{0}.\mathrm{Max}({*}P)$

The main issue is what the output of this function is, when the domain condition is not met. I assume that there is a 'third value' among individuals, #. An individual outside the typical domain.

5. Additional tricky cases

5.1 Few

(154) a. He was one of the few dogs I'd met in years that I really liked.
(Sue Grafton, A is for Alibi, Hoeksema ms.)
b. Few Americans have ever been to Spain.
Few Canadians have either. (Rullman 2003, p.345)
c. He invited few people$_i$ until he knew she liked them$_i$.
(de Swart 1996)

(155) a.I typically don't have many students with any background in linguistics.
b. SOME <MANY, EVERY>

(156) **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.

(157) a. A function f of type <<e,t>,t> is <u>Intolerant</u> iff
if f is not <u>trivial</u>[2], then for all x of type <e,t>, f(x)=0 or f(¬x)=0.
b. A function f is trivial iff for all x, f(x)=1 or for all x, f(x)=0.

See Löbner 1987, Horn 1989 for intolerance.

(158) 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)

[2] I include this clause to bring out the inclusion relations in **Error! Reference source not found.**. See Appendix 2 for proof that AA ⊆ DE+Intolerant.

c. Fewer than 4 of my friends are linguists and fewer than 4 aren't.

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

(160) 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.

(161) a. There were few potatoes in the pantry.

b.?*There were few in the refrigerator, either.

5.2 Comparative quantifiers

Comparative numeral quantifiers don't appear to give rise to implicatures like simple numeral quantifiers. See also the case of **only**.

(162) Mary ate three cookies

Implicature: Mary didn't eat four cookies.

(163) Mary ate more than two cookies.

#Implicature: Mary didn't eat four cookies.

(164) a. Mary only ate $[\text{three}]_F$ cookies.

b. #Mary only ate more than $[\text{two}]_F$ cookies.

Fox & Hackl 2006 give an account of this phenomenon in terms of scalre density.

(165)Mary ate more than 3 cookies.

Mary ate more than m cookies.

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

(166) Universal Density: $\forall d1,d2\ [d1>d2 \rightarrow \exists d3(d1>d3>d2)]$

(167) Bill didn't smoke 30 cigarettes.

#Implicature: Bill smoked 29 cigarettes.

But, comparative numeral quantifiers do not license strong NPIs. For example:

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

A possible response, along the lines of Krifka 1998:

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

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

5.3 *Zero* and explicit proportions

Another problem we confront is apparent synonymy among operators that differ in licensing abilities.

(171) ⟦no⟧ = ⟦fewer than one⟧ = ⟦exactly zero⟧

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

(173) a. Zero students left early
b. No/*Zero students like SEMANTICS, either.

Other diagnostics that separate **no** and **zero**.

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

(175) ?Zero students said anything.

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

(177) 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.

Hypothesis: some categories are interpreted as variables at logical form. The grammar will only attribute a property – like DE-ness – to a constituent if it has that property on all assignments to those variables.

If that is true, then both numerals in (177) will be treated as variables and different assignments to these variables will not respect the ratio of 5 and 9. Thus the grammar may not conclude that the quantifier is intolerant. [Nor can it conclude that it is tolerant.]

6. L-triviality

6.1 Proposal

There is a formally definable subset of the trivial sentences (=tautologies and contradictions) whose members are systematically unacceptable.

Such sentences are identified by their configuration of logical items at LF. Grammar has access to a representation that is underspecified with respect to the content of non-logical expressions.

At some level, all occurrences of non-logical expressions are treated as if independent – even two occurrences of the same expression.

I'll show that this proposal buys an explanation of three semantic restrictions on the occurrence of quantificational determiners.[3]

Puzzle 1: Definiteness Effect in There **Existential Sentences**

There existential sentences (TESs) are compatible with only certain quantificational **there**-associates.

(178) a. There are some curious students.
b. There are no curious students.
c. *There is every curious student.

(179) Other cases
Good: **three**, **a**, **many**, **exactly two**, **at most five**, **few**…
Bad: **all**, **neither**, **both**, **the**, **most** …

[3] These ideas were first sketched in Gajewski (2002). For additional applications of those ideas see Fox & Hackl (2006), Menéndez-Benito (2006), Abrusan (2007).

It has been proposed that the class of determiners that can occur in TESs is semantically specifiable.

(180) **there**-associate quantifiers are…
a. Barwise & Cooper (1981): Weak [see definition in (189) below]
b. Zucchi (1995): Non-presuppositional
c. Keenan (2003): Left conservative[4]

Puzzle 2: Selection Properties of Connected Exceptives

Connected Exceptive Phrases (CEPs) like English *but John* (not free exceptives like *except for Sue*) are very picky about the quantifiers that host them.

(181) a. *Some student but Sue passed the exam.
b. No student but Sue passed the exam.
c. Every student but Sue passed the exam.

(182) Other cases
Good: **none, all**
Bad: the rest

The class of acceptable hosts for CEPs seems to be semantically definable as well; they are just the universal and negative universal quantifiers (cf. von Fintel 1993 a.o.).

(183) Possible hosts for CEPs are (negative) universals
[The class might also be described as the left anti-additive[5] determiners. cf. van Benthem 1984]

Puzzle 3: Negative 'Islands' in Comparatives

Not all quantifiers can appear acceptably inside a comparative clause (CC) (in certain positions).

(184) a. Mary is taller than **some** other student is.
b. *Mary is taller than **no** other student is.

[4] A determiner D is left conservative iff for all A,B: $[\![D]\!](A)(B)=1$ iff $[\![D]\!](A\cap B)(B)=1$
[5] A determiner D is left anti-additive iff for all A,B,C: $[\![D]\!](A\cup B)(C)=1$ iff $[\![D]\!](A)(C)=1 \wedge [\![D]\!](B)(C)=1$

c. Mary is taller than **every** other student is.

(185) Other cases
Good: the rest
Bad: **few**, **fewer than 4**, **at most 7**, **not every** …

Again the class of problematic quantifiers appears to be defined by a semantic property: negativity, or more formally, downward entailingness (cf. von Stechow 1984, Rullmann 1995).

(186) **Downward entailing** quantifiers are unacceptable in comparative clauses.

Summary
We have seen three semantically describable restrictions on the acceptability of quantificational determiners.

	CEPs	CCs	TESs
Some			
No			
Every			

A semantic explanation of these phenomena is in order.

6.2 A Biased Survey of Approaches to these Puzzles

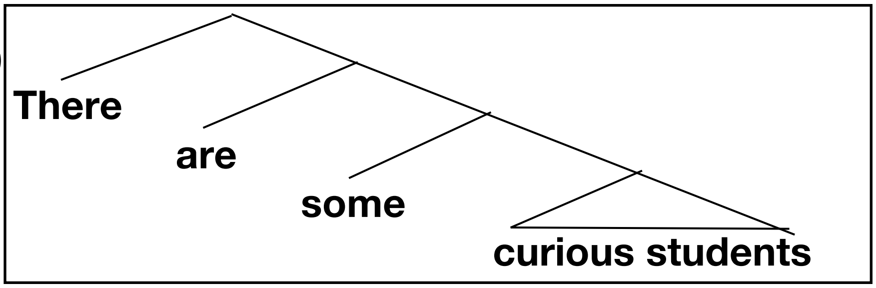
In this section, we see that in each case it has been proposed that unacceptability arises from trivial truth-conditions: the bad sentences are either tautologies or contradictions.

6.2.1 Barwise & Cooper 1981 on Puzzle 1

Barwise & Cooper (B&C) 1981 offer an explanation of the unacceptability of certain quantifiers in TESs based on trivial truth-conditions.

(187) B&C's Proposal[6]
There-associates are predicates that apply to the denotation of the "expletive" **there**.
There denotes the domain of individuals D_e.

[6] This analysis requires a Bare NP approach to *there*-associates and "codas" like that advocated by Williams (1984, 1994, 2006). B&C actually say the construction as a whole predicates Q of D_e.

(188)


(189) a. A determiner D is <u>strong</u> if for every model $M=<[\![\ ]\!],D_e>$ and every $A\subseteq D_e$, if the quantifier $[\![D]\!](A)$ is defined, then $[\![D]\!](A)(A)=1$.
b. D is weak iff D is not strong

(190) a. $[\![$ **every** $]\!](A)(B)$ iff $A\subseteq B$ [STRONG]
b. $[\![$ **some** $]\!](A)(B)$ iff $A\cap B\neq\emptyset$ [WEAK]

B&C show that, given Conservativity[7], all strong determiners have the following property:

(191) If D is strong, then for all $A\subseteq D_e$, then $[\![D]\!](A)(D_e)=1$

Hence, (192)a is a tautology; while (192)b is contingent on the existence of curious students.

(192) a. *There is every curious student.
b. There are some curious students.

Keenan (1987, 2003, a.o.), Zucchi (1995) and Landman (2004), among others, have taken issue with B&C's generalization. There will not be time to address their concerns here.

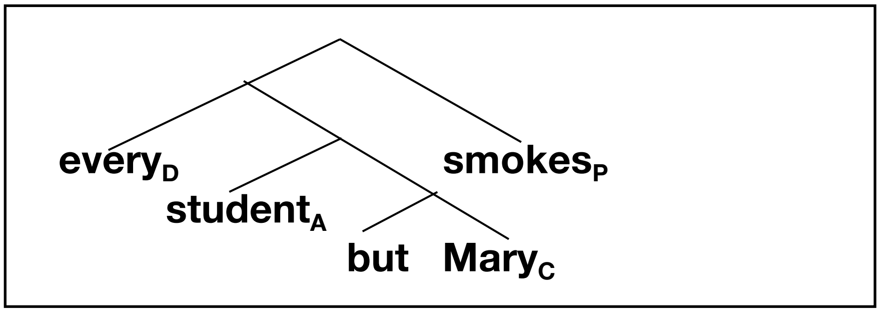
6.2.2 von Fintel 1993 on Puzzle 2

Similarly, von Fintel (1993) attempts to derive the unacceptability of certain CEP hosts from trivial truth-conditions. Gajewski (2008a) extends von Fintel's results to other more complex cases.
A first guess at the semantics:

[7] Conservativity: all natural language determiners are conservative.
A determiner D is conservative iff for all A,B: $[\![$ D $]\!](A)(B)=1$ iff $[\![$ D $]\!](A)(A\cap B)=1$

Logical Form

(193)



(194) $[\![$ **but** $]\!]$(A)(B) = B–A set subtraction

This is inadequate. Under this analysis, (193) does not entail that Mary does **not** smoke. To add this entailment in a uniform way for positive and negative (**no student but Sue**) cases is not trivial.

The solution that von Fintel arrives at is this: the complement of **but** is the <u>least</u> that you <u>have</u> to take out of the restrictor to make the statement true.

(195) $[\![$ **but** $]\!]$(C)(A)(D)(P) = 1 iff
  $D(A\text{-}C)(P) = 1$ and $\forall S[D(A\text{-}S)(P)=1 \rightarrow C \subseteq S]$
  For example, C= {Mary}, D = $[\![$**every**$]\!]$, A = $[\![$**student**$]\!]$, P= $[\![$**smoke**$]\!]$

Essentially, **every** and **no** are the only determiners that systematically allow such minimal exceptions. Nearly all other quantifiers yield contradictions or tautologies in the frame of (193).

In particular, any left upward entailing quantifier (like **some**, **many**, or **three**) will yield a contradiction as a CEP host.

(196) D is left upward entailing iff for all A,B,C s.t. $[\![D]\!](A)(C)=1$ & $A \subseteq B$,
  $[\![D]\!](B)(C)=1$.

If D is upward entailing and you have removed some individuals from D's restrictor and the statement is true, then you always could have removed fewer and had a true statement.[8]

[8] In other words the least you have to remove is nothing (i.e., C = the empty set). Von Fintel (1993) assumes there is a presupposition that C is not empty. We could also just add this to the truth-conditions:
(i) $[\![$ **but** $]\!]$(C)(A)(D)(P) = 1 iff <u>**$C \neq \varnothing$**</u> and $D(A\text{-}C)(P) = 1$ and $\forall S[D(A\text{-}S)(P)=1 \rightarrow C \subseteq S]$

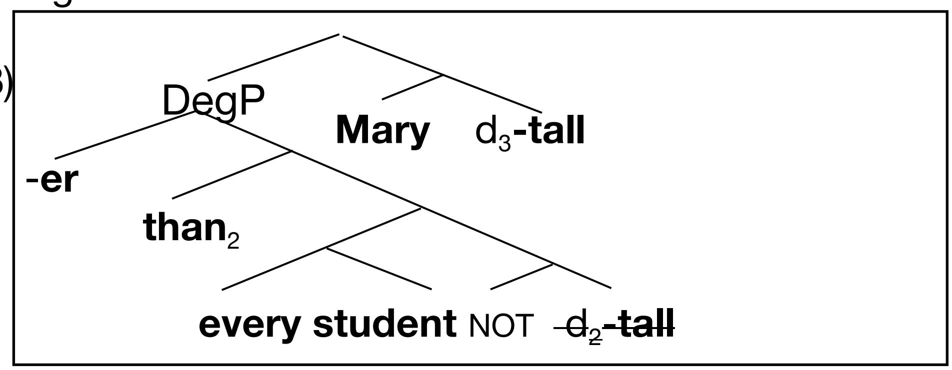
2.3 Puzzle 3

Gajewski (2008b) offers an account of negative 'islands' in comparatives in terms of trivial truth-conditions – following an idea proposed and rejected in von Stechow (1984).

(197) a. Mary is taller than every other student is.
b. *Mary is taller than no other student is.

Logical Form

(198)



(199) A **is** P**-er than** Q **is** is True iff
∃d[A is d-P and Q is <u>not</u> d-P]
Alternatively: {d: A is d-P}∩{d: Q is not d-P}≠∅

(200) A gradable adjective P is <u>monotonic</u> iff if P(d)(x) =1 and d'<d, then P(d')(x)=1.

(201) {d: Mary is d-tall}∩{d: every student is not d-tall}≠∅

When Q is Downward entailing, this combined with the monotonicity yields tautologies given the scheme for comparative truth-conditions in (199).

(202) A quantifier Q is <u>downward entailing</u> (DE) iff for all A, B s.t A⊆B and ⟦Q⟧(B)=1, ⟦Q⟧(A)=1.

(203) a. {d: Mary is d-tall} = [0,Mary's height]
b. {d: every student is not d-tall} =
{d: no student is d-tall} = (the tallest student's height,∞)

c. {d: no student is not d-tall} =
{d: every student is d-tall} = [0,the shortest student's height]

When Q is DE, then CC is downward closed. That is, CC denotes an initial segment of the scale. MC is always an initial segment of the scale. Hence, they always overlap.

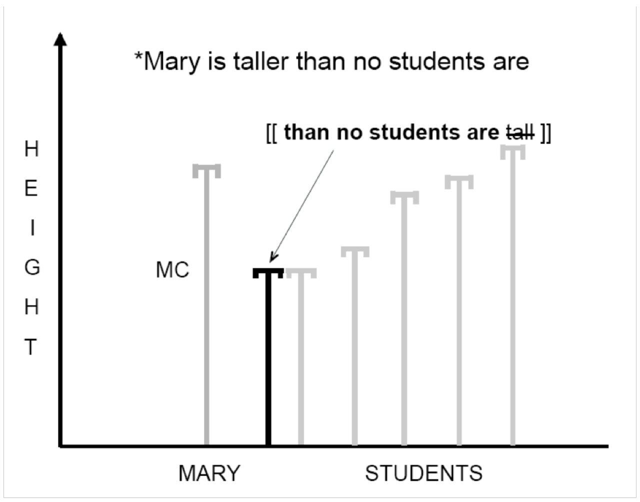


Figure 1

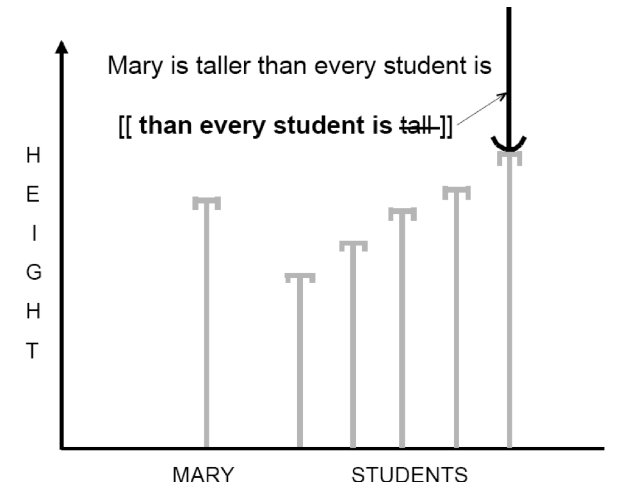


Figure 2

6.3 THE GREAT CONCERN

Tautologies and contradictions aren't (always) unacceptable/ungrammatical!

(204) a. It is raining and it isn't raining.
b. If Fred is wrong, then he is wrong.
c. Figure A is hexagonal or Figure A is not hexagonal.
d. Every square is a square.

Even the authors of the analyses surveyed above have their doubts: [my emphasis]

> **While tautologies and contradictions are not ungrammatical**, they are not very informative and are normally restricted to use in special situations construed as set phrases.
>
> Barwise & Cooper 1981, p.183

> The conceptual problem with this is that, in general, **tautologies or contradictions are not ungrammatical**.
>
> von Fintel 1993, p.133

> One might object against this solution that [a sentence like (197)b] is **rubbish** and should not express a tautology, i.e. something very precious to the philosopher or mathematician.
>
> von Stechow 1984, p.334

Ladusaw (1986)/Kennedy (1997) explicitly deny the viability of such a program. Ladusaw (1986) cites grammatical trivial sentences like (205).

(205) a. My brother is an only child.
b. Either it will rain tomorrow or it won't.

I agree that sentences with trivial truth-conditions are not necessarily unacceptable. What I propose, however, is that there is a formally identifiable proper subset of the trivial sentences whose members are systematically unacceptable.[9] I call these sentences L-trivial.

My proposal has two parts:

Part 1. Lexical Items are sorted into two classes that play significantly different roles in grammar. The classes track to some extent the logical/non-logical distinction. Part 2. Non-logical terms are in some sense invisible to the grammar - to the extent that grammatical mechanisms do not even recognize two instances of the same non-logical expression as the same.

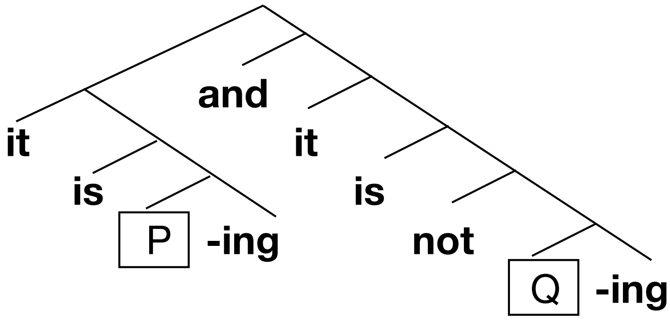
For the time being let's assume the sorting of lexical items has been accomplished and examine Part 2.

6.3.1 Logical Skeleton

The idea is this. Take a typical example of a tautology like (204)a. The distinction among lexical items will put lexical content predicates like *rain* on the non-logical side. I propose the grammar pays little attention to these. As far as the grammar is concerned, the structure of (204)a might as well be

[9] See Chierchia 1984 for another proposal of this kind.

(206)



The sentence (204)a shares this skeleton with other perfectly contingent statements, e.g., **It is raining and it isn't snowing**. Thus, (204)a is acceptable.

Call the structure of a sentence scrubbed of information on identity of non-logical elements its **Logical Skeleton**:

(207) Logical Skeleton
To obtain the Logical Skeleton (LS) of an LF α
a. Identify the maximal constituents of α containing no logical items
b. Replace each such constituent with a fresh constant of the same type

(208) a. LS of (204)b: [**if** a **is** P, **then** b **is** Q]
b. LS of (204)c: [a **is** P **or** b **is not** Q]
c. LS of (204)d: [**every** P **is a** Q]

The intuition behind the Logical Skeleton is that the grammar treats all occurrences non-logical constants as independent.

Historical Note
This idea has a precursor in Körner's (1955, 1960) logic of inexact concepts. Körner's two-tiered, three-valued logic effectively made all instances of propositional variables independent. As Williamson (1994, p.108 ff.) notes such a propositional logic has no tautologies or contradictions, and hence supports no theory of inference.

3.2 (Non-)Logical Expressions

I propose that the key elements of the Logical Skeleton are logical expressions, i.e., expressions whose denotations meet certain invariance conditions.

Much of the discussion in the philosophical literature on the identification of logical constants centers around invariance conditions. (Tarski 1966/1986, Mautner 1946, Mostowski 1957… and many more.)

An element of a denotation domain is invariant if it remains the same under certain dramatic changes to the domain. The most commonly used change is permutation of the domain of individuals D_e.

The central intuition here is that invariant elements are topic-neutral; they are insensitive to the identity of particular individuals.

(209) A permutation π of D_e is a one-to-one mapping from D_e to D_e.

Permutations of D_e can be extended to permutations of all types (cf. van Benthem 1989).

(210) D_e is the domain of individuals
$D_t = \{0,1\}$
$D_{<a,b>}$= the set of functions from D_a to D_b

(211) Given a permutation π of D_e:
$\pi_e = \pi$
$\pi_t(x) = x$, for all x in D_t
$\pi_{<a,b>}(f) = \pi_b \circ f \circ \pi_a^{-1}$, for all f in $D_{<a,b>}$

(212) An item $f \in D_a$ is permutation invariant if $\pi_a(f) = f$, for all permutations π_a on D_a.

(213) A sample of Invariant items
a. D_e: none
b. D_t: 0, 1
c. $D_{<e,t>}$: $\emptyset$, D_e [properly, their characteristic functions]

(214) A lexical item c of type σ is logical iff c denotes a permutation invariant element of D_σ in all models.[10]

[10] This is an oversimplification, see McGee (1996), MacFarlane (2000), and Peters & Westerstahl (2006) for more sophisticated definitions.

6.3.3 Application to Puzzles 1-3

6.3.3.1 There **Existential Sentences**

The denotation of **there** is an invariant element of $D_{<e,t>}$.

(215) ⟦ **there** ⟧ = D_e

The denotations of determiners **some** and **every** are invariant in $D_{<et<et,t>>}$, see e.g. van Benthem 1989.

(216) **There are some curious students.**
Logical skeleton: [**there** [**are** [**some** $P_{1,<e,t>}$]]]
Interpretation: ⟦**some**⟧(I(P_1))(D_e)

(217) ***There is every curious student.**
Logical skeleton: [**there** [**is** [**every** $P_{1,<e,t>}$]]]
Interpretation: ⟦**every**⟧(I(P_1))(D_e)

Now we want to use the LS of (217) to explain its unacceptability. The idea is that even once we've scrubbed out the identity of the non-logical expressions, we can still deduce the triviality of (217).

(218) A sentence S is L-trivial iff S's logical skeleton receives the truth-value 1 (or 0) in all interpretations.

No matter what denotation an interpretation assigns to P_1 in the LS of (217), we know the sentence is true. This follows directly from the fact that **every** is strong, cf.(191). Similarly because **some** is weak, we know (216) is not L-trivial.

(219) A sentence is ungrammatical if its Logical Form contains a L-trivial constituent sentence.

6.3.3.2 Exceptives

(220) ⟦ **but** ⟧ is invariant in $D_{<et,<et,<<et,<et,t>>,<et,t>>>}$

See Peters & Westerståhl (2006) for proof that similar operators are invariant.

(221) **Every student but Mary smokes**
Logical skeleton: [**every** [P_1 **but** P_2] P_3]
Interpretation: ⟦**every**⟧$(I(P_1)-I(P_2))(I(P_3))$ =1 and
∀S[⟦**every**⟧$(I(P_1)-S)(I(P_3))=1 \rightarrow I(P_2) \subseteq S$]

(222) ***Some student but Mary smokes**
Logical skeleton: [**some** [P_1 **but** P_2] P_3]

Some interpretations of the predicate constants P_1, P_2 and P_3 will map (221) to true; and some to false. As we saw above, all interpretation of these constants will map (222) to false. Hence (222) is L-trivial and ungrammatical.

6.3.3.3 Comparatives

(223) Mary is taller than every student is ~~tall~~
Logical skeleton: [A **is** P_1-**er** [**than** [**every** P_2] **is** P_3]]

(224) *Mary is taller than no student is ~~tall~~
Logical skeleton: [A **is** P_1-**er** [**than** [**no** P_2] **is** P_3]]

Note that by the algorithm (207) the two occurrences of degree predicates – which are not logical – in a comparative construction must be treated independently.

I propose that, despite this, L-triviality still holds. This follows if we place restrictions on the domain $D_{<d,<e,t>>}$.

(225) Constraints on the class of gradable predicates
a. All gradable adjectives are <u>monotonic</u>.
b. The domains of gradable adjectives are restricted to <u>scales</u>.

(226) a. ⟦ **tall** ⟧ = $\lambda d: d \in \mathbf{S_{height}}.\lambda x{:}\exists d \in S_{height}[\text{HEIGHT}(x)=d].d \leq \text{HEIGHT}(x)$
b. ⟦ **old** ⟧ = $\lambda d: d \in \mathbf{S_{age}}.\lambda x{:}\exists d \in S_{age}[\text{AGE}(x)=d].d \leq \text{AGE}(x)$

If the scales of P_1 and P_3 do not match, as in (226)a&b, then (224) is undefined. If they share a scale, then since both are monotonic the result is a tautology. This means that we must adjust the definition of L-triviality.

(227) A sentence S is L-trivial iff S's logical skeleton receives the truth value 1 (or 0) in all interpretations in which it is defined.

6.4. Problems for L-triviality.

6.4.1 Domain-denoting expressions

As mentioned above, the characteristic function of D_e is an invariant element in $D_{<e,t>}$. B&C hypothesize that **there** denotes D_e. It is natural to ask whether any other expressions denote D_e.

Some natural candidates: **exist**, **self-identical**

(228) a. Bill exists.
b. Sue is self-identical.

First, does **exist** mean the same thing as being in the domain? Are TESs equivalent to corresponding **exist** sentences? The answer to the second question is clearly no.

Second, what do we make of technical vocabulary like **self-identical**?

Suppose that we decide that ⟦ **exist** ⟧ = ⟦ **self-identical** ⟧ = D_e. We may still preserve our account. **Exist** and **self-identical** differ from the previous items we examined in being open-class. We might then limit the terminals of Logical skeletons to closed-class logical constants.

6.4.2 Reflexives and variable binding

The copula and reflexives ought to be treated as belonging to a closed class. Under certain semantic analyses, they are both logical. This presents a problem to the L-triviality account:

(229) Bill is himself.

(230) a. ⟦ **be** ⟧ = $\lambda x.\lambda y.x=y$ [cf. Sharvit 2003]
b. ⟦ **himself** ⟧ = $\lambda f.\lambda x.f(x)(x)$ [cf. Keenan 2006]
c. ⟦ **be himself** ⟧ = $\lambda x.x=x = D_e$

How could we handle such cases? The main point of stress here seems to be the reflexive. If reflexives are not reflexivizing operations but bound variables, we can connect this problem to another.

(231) Bound variable analysis: Bill 1[t_1 is himself_1]

We can take any trivial sentence, co-bind its arguments and obtain an – ostensibly – L-trivial sentence.[11]

(232) Tall is what Bill is and isn't
Tall is [what_2 Bill is $t_{2,<e,t>}$ and is not $t_{2,<e,t>}$]

Co-bound variables present a problem for the current formulation of the L-trivial principle. This suggest to me that the next step in this investigation is to determine the role of indices and variable binding in the Logical Skeleton. I leave this for future research. [Van Benthem 1989 calls variable binding a *transcendental operation* and raises the issue of its logicality – without resolution.]

6.5 Functional Categories: F-triviality?

Could the distinction that we are after here just be the familiar functional/lexical distinction?

Abney (1987) on properties of functional items:
1. **Closed-class** 2. Phono/morphologically dependent 3. Unique complement 4. Inseparable from complement 5. **Lack descriptive content**: semantic contribution is second order.

Von Fintel (1995) on functional items:
1. **Permutation invariant**. 2. High type. 3. Subject to universal constraints.

A controversial case is prepositions. This is crucial for the exceptive marker *but*. They are sometimes taken to be a lexical class (see, e.g., Jackendoff 1977) but are closed class. See Baker (2003) for a recent argument that adpositions are functional.

[11] Thanks to Danny Fox for bringing this kind of example to my attention.

How would a *sui generis* item like expletive **there** fit into the functional/lexical split? Is this a pro-PP?

An analogy with the f-node/l-node distinction in Distributed Morphology is particularly intriguing.[12] While f-nodes are fully specified with (semantic) features, l-nodes are marked with minimal grammatical information. For example, the difference between **cat** and **dog** is not represented grammatically until the late-insertion of Vocabulary items (cf. Marantz 1997, Harley and Noyer 1998).

If this model is correct, we could dispense with the algorithm constructing the Logical Skeleton. The Logical Skeleton would simply be the syntactic structure before Vocabulary Item insertion.

6.6 Conclusion

There is a subset of trivial sentences defined by L-triviality that are systematically unacceptable.

There are two steps to identifying an L-trivial sentence.

First divide the terminal elements of LF into logical/functional and non-logical/lexical expressions.

Mark all non-logical lexical expressions as distinct from each other.

A sentence whose truth-value depends in no way on the interpretation of non-logical expressions is L-trivial. L-triviality results in unacceptability.

APPENDIX

As it stands it is too easy to circumvent the conditions that I have placed on the constructions above. Conjoining a problematic quantifier with an unproblematic one, for example, should improve certain sentences, but does not.

For example, neither (233)a nor (233)b contains an L-trivial constituent as defined above. Both are still bad.

(233) a. *There is [every curious student and no boring professor].
b. *Fred is taller than [no student and every professor] is.

[12] Thanks to Danny Fox for this suggestion.

This suggests to me that we need a stronger ban. Currently, we say that a sentence is ungrammatical if its Logical Skeleton contains a constituent **c** of type t all of whose non-logical parts are irrelevant to determining the value of **c**.

A natural strengthening of the principle that covers the data in (233) would be:

(234) A sentence S is ungrammatical if its Logical Skeleton contains a non-logical terminal element that is irrelevant to determining the semantic value of S.

(235) a. LS of (233)a: [**there** [**is** [**every** P **and no** Q]]
b. LS of (233)b: [a **is** P-**er than** [**no** P **and every** Q] **is**]

It is easy to see, for example, that P in (235)a never plays any role in determining the truth-value of (235) as a whole.

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