L-triviality and Grammar

Jon Gajewski, University of Connecticut

UConn Logic Group
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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.[1]

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

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

(1) a. There are <u>some</u> curious students.
b. There are <u>no</u> curious students.
c. *There is <u>every</u> curious student.

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

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

(3) **there**-associate quantifiers are…
a. Barwise & Cooper (1981): Weak [see definition in (12) below]
b. Zucchi (1995): Non-presuppositional
c. Keenan (2003): Left conservative[2]

Puzzle 2: Selection Properties of Connected Exceptives

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

[2] A determiner D is <u>left conservative</u> iff for all A,B: $[\![D]\!](A)(B)=1$ iff $[\![D]\!](A\cap B)(B)=1$

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

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

(5) 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.).

(6) Possible hosts for CEPs are (negative) universals
[The class might also be described as the left anti-additive[3] 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).

(7) a. Mary is taller than **some** other student is.
b. *Mary is taller than **no** other student is.
c. Mary is taller than **every** other student is.

(8) 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).

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

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

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

	CEPs	CCs	TESs
Some			
No			
Every			

A semantic explanation of these phenomena is in order.

2. A Biased Survey of Approaches to these Puzzles

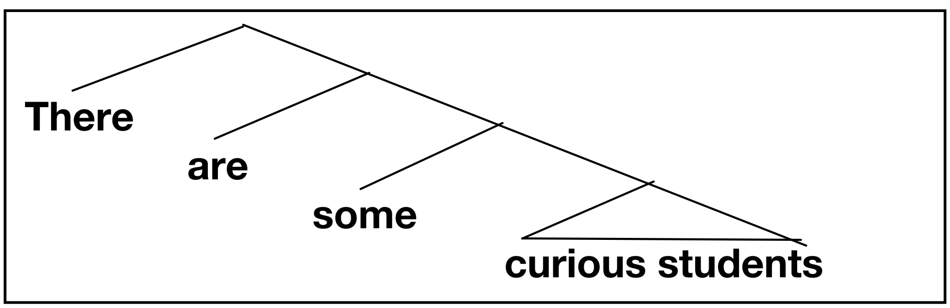
In this section, we see that in each case it has been proposed that unacceptability arises from trivial truth-conditions: the bad sentences are either tautologies or contradictions.

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.

(10) B&C's Proposal[4]
There-associates are predicates that apply to the denotation of the "expletive" **there**.
There denotes the domain of individuals D_e.

Logical Form

(11) 

(12) a. A determiner D is <u>strong</u> if for every model $M=\langle [\![\ ]\!], D_e \rangle$ 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

(13) 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[5], all strong determiners have the following property:

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[4] 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.
[5] Conservativity: all natural language determiners are conservative.

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

Hence, (15)a is a tautology; while (15)b is contingent on the existence of curious students.

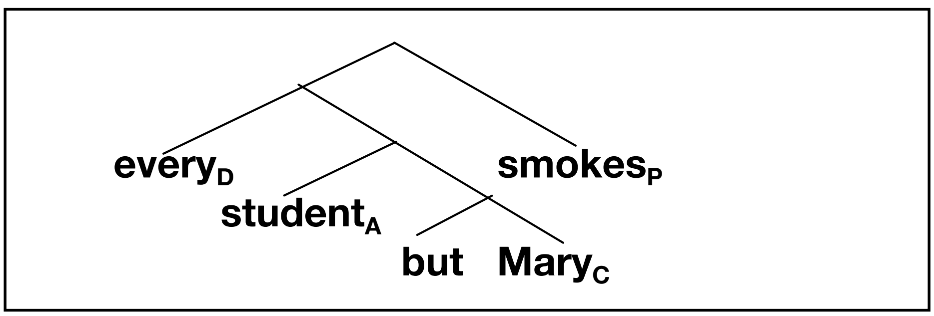
(15) a. *There is every curious student.
b. There are some curious students.

The analysis is remarkably powerful and correct. Keenan (1987, 2003, a.o.) has taken issue with B&C's generalization.

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:

Logical Form

(16) 

(17) $[\![\textbf{but}]\!](A)(B) = B–A$ set subtraction

This is inadequate. Under this analysis, (16) 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.

(18) $[\![\textbf{but}]\!](C)(A)(D)(P) = 1$ 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 = $[\![\textbf{every}]\!]$, A = $[\![\textbf{student}]\!]$, P= $[\![\textbf{smoke}]\!]$

A determiner D is conservative iff for all A,B: $[\![D]\!](A)(B)=1$ iff $[\![D]\!](A)(A \cap B)=1$

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 (16).

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

(19) 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.[6]

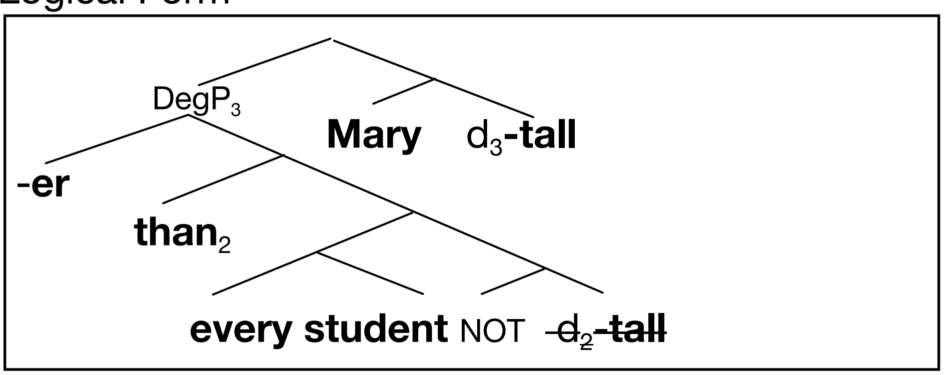
2.3 Puzzle 3

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).

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

Logical Form

(21)



(22) 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}≠∅

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[6] 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≠∅**</u> and D(A-C)(P) =1 and ∀S[D(A-S)(P)=1 → C⊆S]

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

(24) $\{d: \text{Mary is d-tall}\} \cap \{d: \text{every student is not d-tall}\} \neq \varnothing$

When Q is Downward entailing, this combined with the monotonicity yields tautologies given the scheme for comparative truth-conditions in (22).

(25) A quantifier Q is <u>downward entailing</u> (DE) iff for all A, B s.t $A \subseteq B$ and $[\![Q]\!](B)=1$, $[\![Q]\!](A)=1$.

(26) a. $\{d: \text{Mary is d-tall}\}$ = $[0, \text{Mary's height}]$
b. $\{d: \text{every student is not d-tall}\}$ =
$\{d: \text{no student is d-tall}\}$ = $(\text{the tallest student's height}, \infty)$
c. $\{d: \text{no student is not d-tall}\}$ =
$\{d: \text{every student is d-tall}\}$ = $[0, \text{the shortest student's height}]$

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.

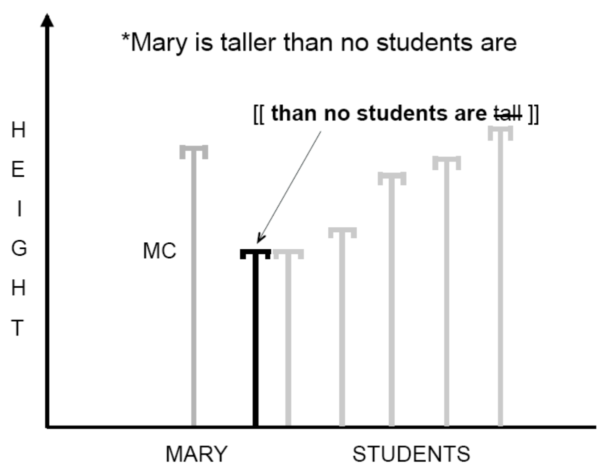


Figure 1

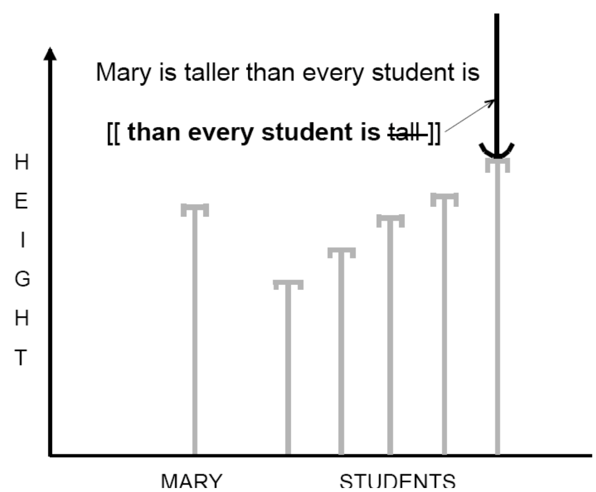


Figure 2

3. THE GREAT CONCERN

Tautologies and contradictions aren't unacceptable/ungrammatical!

(27) 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 (20)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 (28).

(28) 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 <u>necessarily</u> unacceptable. What I propose, however, is that there is a formally identifiable proper subset of the trivial sentences whose members are systematically unacceptable.[7] I call these sentences <u>L-trivial</u>.

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.

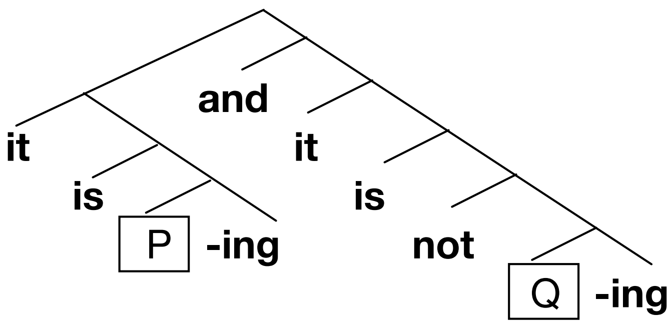
For the time being let's assume the sorting of lexical items has been accomplished and examine Part 2.

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

3.1 Logical Skeleton

The idea is this. Take a typical example of a tautology like (27)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 (27)a might as well be

(29)



The sentence (27)a shares this skeleton with other perfectly contingent statements, e.g., **It is raining and it isn't snowing**. Thus, (27)a is acceptable.

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

(30) <u>Logical Skeleton</u>
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

(31) a. LS of (27)b: [**if** a **is** P, **then** b **is** Q]
b. LS of (27)c: [a **is** P **or** b **is not** Q]
c. LS of (27)d: [**every** P **is a** Q]

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

<u>Historical Note</u>
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 <u>topic-neutral</u>; they are insensitive to the identity of particular individuals.

(32) 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).

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

(34) 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 $D_{<a,b>}$

(35) An item $f \in D_a$ is <u>permutation invariant</u> if $\pi_a(f) = f$, for all permutations π_a on D_a.

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

(37) A lexical item c of type σ is logical iff c denotes a permutation invariant element of D_σ in all models.[8]

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

3.3 Application to Puzzles 1-3

3.3.1 There **Existential Sentences**

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

(38) $[\![$ **there** $]\!] = D_e$

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

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

(40) ***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 (40) 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 (40).

(41) A sentence S is <u>L-trivial</u> 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 (40), we know the sentence is true. This follows directly from the fact that **every** is strong, cf.(14). Similarly because **some** is weak, we know (39) is not L-trivial.

(42) $\boxed{\text{A sentence is ungrammatical if its Logical Form contains a L-trivial constituent sentence.}}$

3.3.2 Exceptives

(43) $[\![$ **but** $]\!]$ is invariant in $D_{<et,<et,<<et,<et,t>>,<et,t>>>}$

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

(44) **Every student but Mary smokes**
Logical skeleton: [**every** [P_1 **but** P_2] P_3]

Interpretation: $[\![\textbf{every}]\!](I(P_1)-I(P_2))(I(P_3)) = 1$ and
$\forall S[[\![\textbf{every}]\!](I(P_1)-S)(I(P_3))=1 \rightarrow I(P_2)\subseteq S]$

(45) ***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 (44) to true; and some to false. As we saw above, all interpretation of these constants will map (45) to false. Hence (45) is L-trivial and ungrammatical.

3.3.3 Comparatives

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

(47) *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 (30) 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 $D_{<d,<e,t>>}$.

(48) 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>.

(49) a. $[\![\textbf{tall}]\!] = \lambda d{:}\ d\in\boxed{\mathbf{S_{height}}}.\lambda x{:}\exists d\in S_{height}[\mathrm{HEIGHT}(x)=d].d \leq \mathrm{HEIGHT}(x)$
b. $[\![\textbf{old}]\!] = \lambda d{:}\ d\in\boxed{\mathbf{S_{age}}}.\lambda x{:}\exists d\in S_{age}[\mathrm{AGE}(x)=d].d \leq \mathrm{AGE}(x)$

If the scales of $P_1$and P_3 do not match, as in (49)a&b, then (47) 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.

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

4. Problems for L-triviality.

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**

(51) 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 <u>closed-class</u> logical constants.

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:

(52) Bill is himself.

(53) 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.

(54) 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.[9]

(55) 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.]

5. Discussion: Functional Categories

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 typically 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.

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.[10] 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).

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[9] Thanks to Danny Fox for bringing this kind of example to my attention.
[10] Thanks to Danny Fox for this suggestion.

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. 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 (56)a nor (56)b contains an L-trivial constituent as defined above. Both are still bad.

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

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 <u>all</u> of whose non-logical parts are irrelevant to determining the value of **c**.

A natural strengthening of the principle that covers the data in (56) would be:

(57) 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.

(58) a. LS of (56)a: [**there** [**is** [**every** P **and no** Q]]
b. LS of (56)b: [a **is** P-**er than** [**no** P **and every** Q] **is**]

It is easy to see, for example, that P in (58)a never plays any role in determining the truth-value of (58) as a whole.

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