Inside Out:
A Note on the Hierarchical Update of Nominal Modifiers*

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Abstract: Some sentences are globally informative but still deviant because they contain an expression that is redundant relative in its local environment, as in: *#Ann is staying in Paris and she in France*. In this case, the second conjunct seems to be evaluated after the first. In several frameworks, order of evaluation follows from linear order. Focusing on nominal modification in Japanese and Korean, Ingason (2016) argued that the correct notion of order is hierarchical, not linear, and he proposed that structurally higher elements are evaluated before lower elements, a conclusion that might dovetail with Romoli and Mandelkern's (2017) proposal for postposed *if*-clauses in conditionals. While agreeing with Ingason's conclusion that for nominal modification evaluation order is hierarchical, we amend his theory by considering sentences with several pre- or post-nominal modifiers (in English, Mandarin and French). We argue that a Noun Phrase is evaluated 'inside out', starting with the head noun and adding modifiers by order of structural proximity to the head – with the result that higher modifiers are evaluated later than lower modifiers (against the 'higher is earlier' view). We then explore how this finding can be integrated with existing accounts of evaluation order for other constituent types, such as conjunction.

Keywords: local contexts, redundancy, triviality, incremental local contexts, presupposition projection

1   The debate on the order of dynamic updates

Stalnaker 1978 stated two conditions that must be satisfied by an expression E relative to its local context c: the presuppositions of E should be entailed by c; and E should be non-trivial relative to c, in the sense that neither E nor its negation should be entailed by c (this requirement can be stated both for propositional and predicative expressions). In diverse frameworks (e.g. Stalnaker 1974, Heim 1983, Schlenker 2009), the local context of an expression E aggregates information provided by the context with the contribution of linguistic expressions that surround E. A seminal observation was that apparently symmetric connectives such as *and* give rise to order effects, as shown by the contrast between (1)a and (1)b: in the computation of triviality, the first conjunct is evaluated before the second. Mandelkern et al. 2019 provide detailed experimental evidence that presupposition computation follows the same order (*contra* the more complex picture painted by Schlenker 2008, 2009, Chemla and Schlenker 2012, and Rothschild 2008).

(1)   a. Ann is in France and she is staying in Paris.
       b. #Ann is staying in Paris and she is in France.

But what is the right notion of order? Stalnaker 1974 and Schlenker 2008, 2009 base their analysis on a linear, left-to-right order.[1] Focusing on adjectival modification,

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[1] In the tradition of dynamic semantics following Heim 1983, the order of evaluation is structural but can in effect be stipulated on an operator-by-operator basis. For instance, in *if F, G*, the antecedent F is taken to be evaluated before G irrespective of its linear position (hence the same predictions are made for *If F, G* and for *G, if F*). In the analysis of Fox 2008, the order of evaluation is left-right, as in Schlenker 2008, 2009, 2010, but possible sentence completions are defined for a fixed structure: one starts from the parse tree of the target sentence, then one takes as given the expressions and structure that precede a certain words, and

Ingason 2016 refutes this claim: he shows on the basis of illuminating Japanese and Korean examples with prenominal modifiers that the contribution of the noun is computed first despite coming second in linear terms. Thus only a hierarchical (rather than linear) analysis can account for the similarity between the English data in (2) and the Japanese data in (3).

(2)   a. John met [a woman [who is a widow]].
        b. # John met [a widow [who is a woman]]. (Ingason 2016)

(3)   a. Taro-ga   [[yamome-dearu]   zyosei-ni]   atta.
          Taro-Nom   [[widow-cop]   woman-dat]   met
      'Taro met a woman who is a widow.'
      b. # Taro-ga   [[zyosei-dearu]   yamome-ni]   atta.
          Taro-Nom   [[woman-cop]   widow-dat]   met
      'Taro met a widow who is a woman.' (Japanese; Ingason 2016)

Ingason doesn't just claim that nominal updates are hierarchical rather than linear; he argues that "structurally higher elements are entered into the context before lower elements". While we fully agree with Ingason that update order is hierarchical, we propose to amend his specific conclusion. We show that in English, Mandarin, and French, NP modification is computed inside out, starting from the head of the construction, and adding modifiers by structural order of proximity to the head – with the result that higher modifiers are evaluated later (not earlier) than lower modifiers.

Ingason is not alone in pursuing a 'higher is earlier' analysis of update order. The same conclusion was reached on the basis of postposed *if*-clauses by Romoli and Mandelkern 2017. Showing that this analysis is not right for nominal modification will thus add further constraints on theories of update order (none of which has attempted to capture all the relevant facts so far). Without attempting to propose a unified theory, we will sketch how the 'inside out' generalization can be combined with current analyses of update order, although the result isn't without cost (because it allows for construction-by-construction stipulations).

2   Potential theories of update order for NP modifiers

Ingason 2016 appears to argue, like Romoli and Mandelkern 2017, that in the case of nominal modifiers, order of evaluation reflects c-command relations, an analysis we call Theory I, or 'Higher is earlier'. We will argue for Theory II ('Inside Out'), whereby order of evaluation is inside out, starting from the noun. Ingason refutes Theory III ('No vacuous modification'), according to which the data are explained by a prohibition against vacuous modification. Theory IV ('No simpler equivalent alternative') is a variant of Theory III not considered by Ingason, which can account for his data but not minor modifications of them, nor for data we discuss in this piece.

(4)   Theory I, 'Higher is earlier': (Ingason 2016, Romoli and Mandelkern 2017): order of evaluation reflects in this case c-command relations.
    Theory II, 'Inside out' (this paper): order evaluation is in this case 'inside out', starting from the innermost nominal.
    Theory III, 'No vacuous modification' (refuted by Ingason): order needn't matter: vacuous

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one considers all the ways in which the partial parse tree could be completed. In the analysis of Schlenker 2008, 2009, 2010, sentence completions involved all strings that could complete the beginning of the sentence, but brackets in the object language ensured that the initial structure couldn't be modified.

modification is always deviant.
Theory IV, 'No simpler equivalent alternative' (not considered by Ingason): order needn't matter: an expression is deviant if it is equivalent to a simpler alternative (Romoli and Mandelkern 2017 Section 2.2.)

Ingason 2016 refutes Theory III ('No vacuous modification'): (5) is deviant despite the fact that the relative clause as a whole isn't trivial. The source of the deviance is arguably that within its local context, *a woman* is trivial, which requires that *a widow* should be computed first. The facts are similar in Japanese, where the noun comes last, as is expected on a hierarchical account but not on a linear account.

(5) a. # John met [a widow [who is a teacher and a woman]].
     b. John met [a woman [who is a teacher and a widow]]. (Ingason 2016)

Investigating conditionals rather than nominals, Romoli and Mandelkern 2017 consider (and discard) a more sophisticated version of this theory, which we call Theory IV ('No simpler equivalent alternative'): following Katzir 2007, they take simpler alternatives to be obtained by deletions performed on Logical Forms.[2] This theory could account for Ingason's data. (5)a has a strictly simpler alternative obtained by simplifying (5) to (6), which is equivalent. But no such simplification-by-deletion is available in (5)b: by eliminating *teacher* or *widow*, we would obtain non-equivalent alternatives.
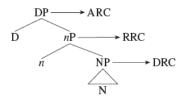
(6) John met [a widow [who is a teacher]].

Without constraints, Theory IV would make incorrect predictions for (1), as both (1)a and (1)b would be blocked. For the same reason, Theory IV makes incorrect predictions for a modification of Ingason's data (J. Romoli, p.c.): both (7)a and b are ruled out. We will see below further arguments against Theory IV in cases that do not involve conjunctions.

(7) a. John met [a teacher [who is in France and is staying in Paris]].
     b. #John met [a teacher [who is staying in Paris and is in France]].

We should note that Ingason's claim that in his structures "the head noun is higher in the structure than the relative clause (...) (Partee 1975; Wiltschko 2012; 2013)" is a bit surprising. Wiltschko 2013 writes that restrictive relative clauses, which are the ones that are relevant here, are in fact attached higher than the head noun, as shown in (8) (she uses *ARC* to refer to Appositive Relative Clauses, *RRC* for Restrictive Relative Clauses, and *DRC* for a new category of non-restrictive, descriptive relative clauses in Austro-Bavarian – and these are indeed argued to be lower).

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[2] This analysis might be seen as a consequence of Katzir's theory (2007) combined with an analysis along the lines of Magri's (2009) theory of blind implicatures. In a nutshell, Katzir's theory defines an ordering on Logical Forms that takes into account both simplicity and informativity: F is at least as good as G, $F \leq G$, iff (i) F is an alternative of G, (ii) F entails G. F is strictly better than G, $F < G$, iff $F \leq G$ and not $G \leq F$. $G \leq F$ fails whenever F is strictly simpler than G, and thus when this is the case and F is equivalent to G, F is strictly better than G. On the assumption that the utterance of F implicates that utterances strictly better than F are false, we could obtain a 'blind implicature' to the effect *not G*, and a contradiction.

(8) Three sites of attachment for three types of relative clauses in Wiltschko 2013

Still, because c-command order in structures of the form *[Noun Relative_clause]* is in part theory-internal, we will replicate Ingason's argument with structures of the form *[Modifier_2 [Modifier_1 Noun]]*, where (i) *Modifier_2* clearly asymmetrically c-commands *Modifier_1*, and (ii) no extent analysis we know of posits that *[Modifier_1 Noun]* asymmetrically c-commands *Modifier_2*. Despite this, we will see that *Modifier_1* gets evaluated before *Modifier_2*.

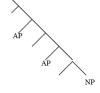## 3   Pre-nominal modification

3.1   'Higher is earlier' isn't right: English

Ingason's argument for a structural analysis of context update can be replicated with English adjectives, as is shown in (9)-(10). Unless otherwise noted, the English data are from a survey of 6 linguists who are native speakers of American English, with average acceptability judgments on a 7-point scale appearing as superscripts at the beginning of sentences; raw data can be found in the Supplementary Materials. (The same contexts will be tacitly assumed throughout, without repetition.)

(9) *Context:* It is known that all Hasids are Jews, although there are Jews that are not Hasids.
Under Nazi occupation, this heroic family hid…
a. [7] a Hasidic Jew.
b. [2.5] a Jewish Hasid.

(10) *Context:* It is known that Ontario is a part of Canada.
Our company has chosen as its representative…
a. [5.2] an Ontarian Canadian.
b. [2.3] a Canadian Ontarian.

The constituency alone doesn't suffice to determine c-command in this case, since it only specifies that *[Hasidic Jew]* and *[Jewish Hasid]* form constituents. But some accounts of pre-nominal modification posit that the linearly earlier adjectives are hierarchically higher, as in the following structure by Cinque 2010 (which includes additional heads; *AP* represents the position of the adjectives):

(11) Cinque's structure for English pre-nominal adjectives

On these views, Ingason's specific conclusion makes the wrong predictions: in (9)-(10)a and (9)-(10)b alike, the noun seems to be computed first, but is predicted to be computed second on the 'higher is earlier' view combined with Cinque's structure.

Problems for the 'Higher is earlier' view become more salient when we consider cases such as (12)-(13)a,b, where constituency suffices to infer that the first adjective asymmetrically c-commands the noun. Still, the judgments suggest that the adjectives is computed after the noun for purposes of triviality assessment. It can be checked in (12)-(13)c,d that the contrast is not due to ordering restrictions on the relevant adjectives independently from the noun, since when the noun is changed so as to remove the triviality, the contrast disappears. For reasons we do not understand, (13)a,b are both degraded, although (13)b is more degraded than (13)a.

(12) Under Nazi occupation, this heroic family hid…
   a. $^{6.3}$ a Hasidic French Jew.
   b. ^{2} a Jewish French Hasid.
   c. ^{7} a Hasidic French child.
   d. $^{6.5}$ a Jewish French child.

(13) Our company has chosen as its representative…
   a. ^{4} an Ontarian female Canadian.
   b. $^{2.2}$ a Canadian female Ontarian.
   c. ^{6} an Ontarian female engineer.
   d. ^{6} a Canadian female engineer.

The only way for Ingason's 'higher is earlier' theory to account for the contrasts would be to argue that even though the head noun is c-commanded by the linearly first adjective, the NP *[French Hasid]* in (12)b c-commands *Jewish*; we know of no evidence for this.

Theory III above ('No vacuous modification') cannot account for a refinement of our data, as in (14)–(15), just as Ingason showed for his.

(14) Under Nazi occupation, this heroic family hid…
   a. ^{7} a Hasidic and dark-skinned French Jew.
   b. $^{2.2}$ a Jewish and dark-skinned French Hasid.
   c. $^{6.7}$ a Hasidic and dark-skinned French child.
   d. ^{7} a Jewish and dark-skinned French child.

(15) Our company has chosen as its representative…
   a. $^{5.5}$ an [Ontarian and French-speaking] female Canadian.
   b. $^{2.8}$ a [Canadian and French-speaking] female Ontarian.
   c. $^{6.7}$ an [Ontarian and French-speaking] female engineer.
   d. $^{6.7}$ a [Canadian and French-speaking] female engineer.

Both Theory II ('Inside out') and Theory IV ('No simpler equivalent alternative') are compatible with (14)-(15). But following Romoli's remark (p.c.), Theory IV fails to draw a distinction between (16)-(17)a and (16)-(17)b (as both example types are predicted to be deviant). Note that all examples are somewhat degraded, which suggests that on top of the asymmetries Ingason was interested in, some conjunctive modifiers might display a penalty for having simpler equivalent alternatives (based on the first or the second disjunct), as posited by Theory IV. Be that as it may, relative contrasts still exist within these degraded pairs, and Theory IV alone cannot account for them.[3]

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[3] This additional mechanism seems to be needed to account for the deviance of the following examples.

(16) Under Nazi occupation, this heroic family hid…
 a. [4.8] a female and pregnant French refugee.
 b. [2.7] a pregnant and female French refugee.

(17) Our company has chosen as its representative…
 a. [5] a female and pregnant Canadian engineer.
 b. [2] a pregnant and female Canadian engineer.

  Theory II ('Inside out') only specifies how the local context of an NP modifier as a whole is computed, and thus it is silent on what happens within the modifier itself. This is compatible with an asymmetry among the two conjuncts, but to achieve this result we will need to find a way to marry the 'inside out' generalization with extent analyses of conjunction; we will sketch a solution in Section 6.

3.2 Ordering among modifiers: English

Theory I ('Higher is earlier') and Theory IV ('No simpler equivalent alternative') are also refuted by cases involving stacked modifiers. Some care is needed to investigate triviality effects in such structures, as they notoriously come with severe ordering restrictions, discussed for instance in Cinque 2010 and Scontras et al. 2019. We start from a case of apparent optionality in the ordering of two adjectives, as in (18)c,d, which are both acceptable for our consultants:[4]

(18) *Context:* it is known that all Italian islands are in the Mediterranean, whereas some French islands are in the Mediterranean and some are not (e.g. some are in the Atlantic).
 This is …
 a. [6.8] an Italian Mediterranean island.
 b. [3.2] a Mediterranean Italian island.
 c. [7] a French Mediterranean island.
 d. [6.8] a Mediterranean French island.

Whatever ordering facts hold between *French* and *Mediterranean* should presumably hold in identical fashion of *Italian* and *Mediterranean*. Despite this, (18)c is degraded, presumably because *Mediterranean* is redundant when applied to *Italian island*.
  These facts are as expected on the 'inside out' approach: the innermost modifier and the noun are computed before the outermost modifier. They are unexpected from the perspective of Theory IV ('No simpler equivalent alternative'): since both *Italian* and *Mediterranean* are modifiers, both (18)a and (18)b should compete with the simpler but contextually equivalent sentence *This is an Italian island*. This correctly predicts that

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(i) Under Nazi occupation, this heroic family hid…
a. [2.3] a Jewish and Hasidic French child.
b. [1.5] a Hasidic and Jewish French child.

(ii) Our company has chosen as its representative…
a. [2] a Canadian and Ontarian female engineer.
b. [1.7] an Ontarian and Canadian female engineer.

We do not know why they are different from those involving *pregnant* and *female* (the fact that *pregnant* triggers a presupposition might be responsible, although *a pregnant engineer* doesn't seem to us to be hard to use, suggesting that this presupposition is easy to accommodate). We leave a closer analysis of conjoined modifiers for future research.

[4] As seen in the Supplementary Materials, two consultants noted that a special prosody was needed in some of these cases. In particular, one consultant wrote: "*a Mediterranean French island*" *might require some special prosody: stress on "Mediterranean"*.

(18)b should be deviant, but this incorrectly predicts that (18)a should be as well. In this case, an ordering asymmetry is crucial.
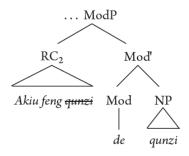
3.3 Extension to Mandarin[5]

The English findings about pre-nominal modification can be extended to Mandarin, where modifiers (be they adjectival or clausal) are pre-nominal as well. Judgments are by three native speakers (also linguists), on a 7-point scale. In (19)b, the outermost modifier is redundant if update order is inside out, but not if it is left-to-right.

(19) *Context:* In 1980 Berlin was divided between East and West Germany. This stopped being the case after the German reunification in 1990.[6]

Wǒ	de	yéye		shì
I	*of*	*paternal-grand-father*		*be*

'My grandfather was

a. [6.3] laízì | Bólín | de | Déguó | rén.
   coming | *Berlin* | *DE* | *German* | *person.*

a German person from Berlin.'

b. [1] laízì | Déguó | de | Bólín | rén.
   coming | *Germany* | *DE* | *Berlin* | *person.*

a <u>Berliner person</u> coming from Germany.'

c. [6.3] laízì | Bólín | de | Dóng Dé | rén.
   coming | *Berlin* | *DE* | *East German* | *person.*

an East German person coming from Berlin.'

d. [6.7] laízì | Dóng Dé | de | Bólín | rén.
   coming | *East Germany* | *DE* | *Berlin* | *person.*

a Berliner person coming from East Germany.'

We don't know of evidence that the noun or adjective-noun combination is hierarchically higher than the relative clause. In fact, in a recent account, due to Lin and Tsai 2014, the relative clause asymmetrically c-commands the rest of the NP, as illustrated in (20).

(20) Lin and Tsai 2014 on the structure of Akiu feng de qunzi, 'a skirt which Akiu sewed'

Just as our English data, these examples don't just refute Theory II ('Inside out'), but also Theory IV ('No simpler equivalent alternative'), according to which the violation stems from the fact that a modifier can be eliminated without affecting the meaning: as in the English data, this fails to explain why a redundant modifier is acceptable if it hierarchically closer to the noun than the modifier that makes it redundant.

[6] We indicate average judgments as superscripts. The full judgments are as follows, the order a., b., c., d.: Consultant 1: 7, 1, 7, 7; Consultant 2: 7, 1, 7, 7; Consultant 3: 5, 1, 5 6.

4   Post-nominal modification

We extend our generalization about 'inside out order' to French. We assume that the constituency of a doubly modified NP has the form *[[NP AP1] AP2]*, with the linearly first modifier forming a constituent with the NP. This is the same constituency as is found in English (and Mandarin), but with a mirror-image of the word order, in accordance with standard views, such as Cinque 2010. We then discuss theoretical consequences of this finding; as we will see, depending on one's syntactic assumptions, they are compatible with an 'inside out' view or with a 'higher is earlier' view (they would be compatible with a linear (left-to-right) account as well, but we take this to have been rendered implausible by Ingason's data).

4.1   'Inside out' order in French[7]

Ingason's observation that modifier update proceeds after taking into account the noun extends to French, as in (21). These facts are compatible with Theories I, II, III and IV, although a modification can rule out Theory III ('No vacuous modification'), as in (22). The controls in (21)c,d show that the adjectival orders in (21)a,b are not the problem; rather, informativity is (note that informativity does not raise issues in the controls because *personne* is grammatically feminine but applicable to males and females alike).

(21) Sam   a   embauché   une
     Sam   has   hired   a-fem
     'Sam has hired a
     a. femme   française   veuve.
        woman   French-fem   widowed-fem
     a widowed French woman.'
     b. # veuve française   de   sexe   féminin.
        widow   French-fem   of   sex   female
     a female French widow.'
     c. personne   française   veuve.
        person-fem   French   widowed
     a widowed French person.'
     d. personne   française   de   sexe   féminin.
        person-fem   French   of   sex   female
     female French person.'

(22) Sam   a   embauché   une
     Sam   has   hired   a-fem
     'Sam has hired a
     a. femme   française   [veuve et   âgée].
        woman   French-fem   widowed-fem and senior
     a widowed and senior French woman.'
     b. # veuve française   [de sexe féminin et âgée].
        widow   French-fem   of sex   female   and senior
     a female and senior French widow.'

Theory IV ('No simpler equivalent alternative') is ruled out by examples with several modifiers, as in (23) and (24); in both paradigms, controls are needed to show that, independent from issues of informativity, both adjectival orders are possible.

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[7] Contrastive judgments are those obtained by the author, confirmed with another linguist who is also a native speaker of French.

(23) *Context:* In 1980 Berlin was divided between East and West Germany. This stopped being the case after the German reunification in 1990.
Uttered in 2019:

a. ? Ceci est une adresse allemande berlinoise.
This is an address German Berliner
'This is a Berliner German address.'

b. #Ceci est une adresse berlinoise allemande.
This is an address Berliner German
'This is a German Berliner address.'

Uttered in 1980:

c. ? Ceci est une adresse est-allemande berlinoise.
This is an address East-German Berliner

d. Ceci est une adresse berlinoise est-allemande.
This is an address Berliner East-German

The same paradigm can be replicated in another case, as in (24):

(24) *Context:* it is known that all Italian islands are in the Mediterranean, whereas some French islands are in the Mediterranean and some are not (e.g. some are in the Atlantic).

a. Ceci est une île méditerranéenne italienne.
This is an island Mediterranean Italian
'This is an Italian Mediterranean island.'

b. #Ceci est une île italienne méditerranéenne.
This is an island Italian Mediterranean
'This is a Mediterranean Italian island.'

c. Ceci est une île méditerranéenne française.
This is an island Mediterranean French
'This is a French Mediterranean island.'

d. Ceci est une île française méditerranéenne.
This is an island French Mediterranean
'This is a Mediterranean French island.'

Ingason's argument against Theory III ('No vacuous modification')) straightforwardly extends to these cases:

(25) Talking about phone numbers in 2019:

a. ? Ceci est un numéro allemand [berlinois et se terminant en 0].
This is a number German Berliner and itself ending in 0.
'This is a German number from Berlin and ending in 0.'

b. #Ceci est un numéro berlinois [allemand et se terminant en 0].
This is a number Berliner German and itself ending in 0.

Talking about phone numbers in 1980:

c. ? Ceci est un numéro est-allemand [berlinois et se terminant en 0].
This is a number East-German Berliner and itself ending in 0.
'This is an East-German number from Berlin and ending in 0.'

d. Ceci est un numéro berlinois [est-allemand et se terminant en 0].
This is a number Berliner East-German and itself ending in 0.
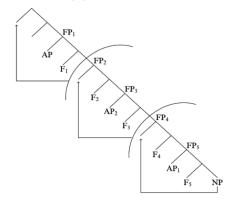'This is a Berlin East-German number ending in 0.'

4.2   Theoretical consequences

While these French examples could be analyzed in a left-to-right fashion, *on the assumption* that the analysis must be hierarchical across languages, they are compatible with an 'inside out' analysis. A 'higher is earlier' theory is possible as well if one posits some movement operations.

Post-nominal adjectival order in French or Italian tends to be the mirror-image of what is found in English. Cinque 2010 derives the Romance structure from the English structure via movement, as in (26).

(26) Cinque's derivation of post-nominal adjectival order in Romance

Starting from a structure […AP2… […AP1 **NP**], a first NP-movement leads to […AP2… **[NP …AP1]]**, and a second movement of the entire bold-faced constituent leads to **[[NP …AP1]** …AP2…]. In the end, the constituency is the same as in the English structure, as seen in (27), but the linear order of the adjectives is the mirror-image of that found in English, which matters in view of known restrictions on this order. One could of course state directly that adjectives are base-generated in English as in (27)a and in Romance as in (27)b, at the cost of losing Cinque's particular account of ordering constraints on adjectives: for him, they follow from a universal hierarchy of functional heads F1, … , F5, … , which select different adjectival types, as seen in (26).

(27) English vs. Romance constituency
      a. English: [AP2 [AP1 NP]]
      b. Romance: [[NP AP1] AP2]

On Cinque's view, the functional structure found in (26) (a more detailed version of (11) above) leads one to expect that completely different relations of asymmetric c-command should be found in English and in Romance: although the basic structural relations are the same, they get modified by NP movement in Romance, thence the differences stated in (28).

(28) Asymmetric c-command relations with Cinque's structure in (26)
      a. English: AP2 > AP1 > NP
                                            AP2 > [AP1 NP]
      b. Romance (after movements):   NP > AP1
                                            [NP AP1] > AP2

On Theory I ('Higher is earlier'), the Romance c-command relations in (28)b are compatible with the French data, but they derive from an analysis of English that isn't, since on this view of the functional structure English would lead one to expect that AP2 is evaluated before [AP1 NP], as shown in (28)a. This means that either Cinque's analysis is incorrect, or update order based on asymmetric c-command needs to be revised.

It should be added that on a base-generation view of the structure in (27), one won't derive the correct c-command relations either without positing further covert functional structure: we would need to somehow obtain the result that in (27)a, despite

the constituency, *NP* asymmetrically c-commands *AP1*, and *[NP AP1]* asymmetrically c-commands *AP2*. We know of no evidence for a covert functional structure with these consequences.

4.3   Interim summary

Ingason's own data were not clearly compatible with Theory I ('Higher is earlier'), since he needed to posit non-standard structural relations between the head noun and the relative clause to make a 'higher is earlier' theory work. The data we adduced from English and Mandarin suggest that the 'inside out' generalization is correct – against the 'higher is earlier' view. The French data are compatible with the 'inside out' theory. In addition, on the assumption that there are Cinque-style movement operations that modify the initial c-command relations as in (26), 'higher is earlier' could also account for our French data as well.[8]

5   Computing local contexts in NP's

How should the local contexts of NP modifiers be computed? This could be specified as part of a recursive semantic procedure, as in dynamic semantics (in the spirit of Heim 1983, who did not discuss modifiers, however). This analysis has been criticized as insufficiently explanatory because *ad hoc* assumptions can be made on an operator-by-operator basis (Soames 1989, Schlenker 2008, 2009, 2010), hence an attempt to define on independent grounds (i) what local contexts are, and (ii) which order they are computed in. While we can preserve the general definition of local contexts offered in Schlenker 2009, 2010, the linear (rather than hierarchical) notion of order employed in these works is hopeless in the present case, as Ingason showed. On the other hand, no general notion of order we know of simultaneously captures the 'inside out' character of NP modifiers and other asymmetries that can be found elsewhere, for instance in conjunctions.

At this point then, some stipulations are needed. We state them by modifying the theory of local contexts of Schlenker 2009, leaving a dynamic account for future research. We start from the extensional fragment of Schlenker 2009, adding to it intersective predicate modifiers. This restriction to intersective modification will simplify the discussion, because by definition for any intersective modifier *M* that applies to a Noun Phrase *N*, *M N* is equivalent to the conjunction of *M* and *N*, e.g. *French scientist* is equivalent to *French and scientist*. No such equivalence holds for *competent scientist* or *fake scientist*: in the first case, we have a modifier that is restrictive (or 'subsective'), but not intersective, as in this case the conjunction wouldn't be equivalent to the meaning we obtain (as Sam can be competent, e.g. as a plumber, without being competent as a scientist, hence *Sam is a competent scientist* doesn't mean that *Sam is competent and Sam is a scientist)*. In the case of *fake scientist*, the modification isn't even restrictive, since fake scientists aren't scientists. Besides issues of simplicity, these differences will matter for the computation of local contexts.

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[8] We make no claim about other languages. Initial Italian data seem to pattern like French. Pre-nominal modification in German and ASL was far more complicated than we expected, and thus we recommend that the data should be explored at some future point.

5.1   Initial definition

As stated in (29), Schlenker 2009, 2010 defined the local context of an expression *d* in a string *a d b* as the strongest conjunctive restriction one could add in advance of computing the value of *d*, in such a way that this conjunctive restriction does not change the truth conditions relative to the global context. But this comes with a linear bias: this condition should be satisfied at the point at which the relevant position is processed, from left to right, no matter how the sentence continues afterwards. This accounts for the fact that the local context of *p* in *(p and q)* does not have access to *q*: the local context is computed without access to information about *q*, and the reason is based on linear order, not structure. By contrast, the local context of *q* does have access to *p*, hence the asymmetry noted in (1).

(29) Local contexts in Schlenker 2009, 2010
      The local context of an expression *d* of propositional or predicative type which occurs in a syntactic environment *a _ b* in a context C is the strongest proposition or property x which guarantees that for any expression *d'* of the same type as *d*, for all strings *b'* for which *a d' b'* is a well-formed sentence,

      C $\vDash^{c' \to x}$ a (c' and d') b' $\Leftrightarrow$ a d' b'

      (If no strongest proposition or property x with the desired characteristics exists, the local context of *d* does not exist[9]).

Before we define a hierarchical notion of local context for restrictive modifiers, we note that the condition in (29) can be given a more abstract form. Starting from a sentence *a d b*, the goal is to compute the local context of the position filled by *d*, namely _ in *a _ b*. The procedure does so by defining a set of alternatives to *a _ b*, of the form *a' _ b'*, and it requires that for all these alternatives, for any *d'* of the same type as *d*, *a (c' and d') b'* should be equivalent to *a d' b'*. Because the account has a linear bias, *a* can be taken as fixed and hence *a' = a*, but once the linear bias is revised, one may need to consider other alternatives.

(30) General form of (29)
      The local context of an expression *d* of propositional or predicative type which occurs in a syntactic environment *a _ b* in a context C is the strongest proposition or property x which guarantees that for any expression *d'* of the same type as *d*, for all appropriately defined alternatives *a' _ b'* to *a _ b* ,

      C $\vDash^{c' \to x}$ a' (c' and d') b' $\Leftrightarrow$ a' d' b'

Because we are revising the linear bias but do not wish to commit to a definition of the alternative strings to consider, we adopt this more abstract condition for the moment, and now focus on sentences of the form *a M N b*, where *N* is a Noun Phrase and *M* is an NP modifier. The local context *c'* of *M* will be defined as the strongest conjunctive restriction one can add in such a way that no matter what *M* turns out to be, the truth conditions won't be affected by the presence of *c'*. For notational simplicity, we will boldface expressions to refer to their semantic value. Thus a predicate *N* has as its semantics value **N**. Furthermore, we assess all semantic types *relative to a world of evaluation*. Thus we will say that a predicate *N* has type <e, t> because **N**(w), also written

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[9] See Schlenker 2009 for a discussion of the case in which local contexts do not exist.

as $\mathbf{N}^w$ if one thinks of w as a parameter, has the type $\langle e, t\rangle$ (in some technical discussions we will need to use the full type $\langle s, \langle e, t\rangle\rangle$).

(31) Local context of an intersective modifier *M* modifying an NP *N* in a structure *[M N]* (or *[N M]*: linear order irrelevant)[10]
The local context of a restrictive modifier *M* of type $\langle e, t\rangle$ modifying a Noun Phrase *N* of type $\langle e, t\rangle$ in a sentence *a M N b* in a context C is the strongest x of type $\langle e, t\rangle$ which guarantees that for any *M'* of type $\langle e, t\rangle$, for all (appropriately defined) alternatives *a' _ b'* to *a _ b*,

a. C $\models^{c' \to x}$ a' ((c' and M') N) b' $\Leftrightarrow$ a' M' N b'

or equivalently (because the modifiers are all intersective),

b. C $\models^{c' \to x}$ a' (N and (c' and M')) b' $\Leftrightarrow$ a' (N and M') N b'

While (31)a is the 'official' definition of the local context of the modifier *M* in a sentence … *MN*…, the equivalent one in (31)b yields a very simple interpretation, as the latter is nothing but the standard definition of the local context of *M* in a predicative conjunction … *(N and M)*… .[11] In other words, the local context of *French* in a sentence of the form … *French scientist*… is the same as its local context in the modified sentence … *(scientist and French)*… . This, in turn, captures our generalization about 'inside out' evaluation: the local context of *M* incorporates information about *N*, despite the fact that *M* linearly follows *M*. If we considered a further modifier *M'* in a sentence … *M' (M N)*…, its local context would be the same as that of *M'* in … *((N and M) and M')*…, and thus it would incorporate information about both *N* and *M*, as is desired.

 To take a concrete example, consider the sentence *Some journalist is a female widow*. We wish to derive the fact that the local context of *female* makes it trivial, hence the deviance of the sentence. We treat this sentence as *(Some J . (F W))*, with *J*, *F* and *W* standing for *journalist, female* and *widow*. On the assumption that the beginning of the sentence is taken into account (as in the linear algorithm), using (31)b, the local context of *F* is defined as in (32)a.

(32) In a context C, the local context of *F* in *(Some J . (F W))* is the strongest x of type $\langle e, t\rangle$ which guarantees that for any *M'* of type $\langle e, t\rangle$,

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[10] As in Rooth and Partee 1982, propositional conjunction is 'lifted' to apply to non-propositional arguments whose type 'ends in t', thanks to the recursive rule in (i)

(i) a. If d and d' are two arguments of type t, **(d and d')** has its 'normal' value.
  b. If d and d' are two arguments of a conjoinable type $\langle a, b\rangle$, **(d and d')** = λx_a . **d**(x) and **d'**(x).

It will be useful to also have a modified rule with a world parameter, as in (ii), with the definition of extensional function application in (iii). (We write f^w for f(w).)

(ii) a. If d and d' are two arguments of type $\langle s, t\rangle$, **(d and d')**^{w} has its 'normal' value, i.e. **d**^{w} and **d'**^{w}.
  b. If d and d' are two arguments of a conjoinable type $\langle s, \langle a, b\rangle\rangle$, **(d and d')**^{w} = λx_a . **d**^{w}(x) and **d'**^{w}(x).

(iii) If x and f are two model-theoretic objects of types $\langle s, \langle a, b\rangle\rangle$ and $\langle s, a\rangle$ respectively, $[f(x)]^w = f^w(x^w)$

As an example, if *N* and *N'* have types $\langle s, et\rangle$, we have: **(N and N')**^{w} = λx_e . **N**^{w}(x) and **N'**^{w}(x), using (ii).
[11] Caution is needed before general results are used, however, since the fragment of Schlenker 2009 includes propositional but not predicative conjunction.

a. C ⊨^{c'→x} (Some J . (W and (c' and M'))) ⇔ (Some J . (W and M'))

or equivalently, due to the meaning of *Some*,[12]

b. C ⊨^{c'→x} (Some (J and W) . (c' and M')) ⇔ (Some (J and W) . M'))

By thinking of *(J and W)* as an elementary predicate *JW*, the condition in (32)b just defines the local context of the verbal predicate *V* in a sentence such as *Some JW V*, e.g. of *smokes* in *Some woman journalist smokes*. In this case as in others, the system of Schlenker 2009 agrees with Heim 1983 and yields a local context that incorporates information about the global context C and the restrictor predicate *JW*:[13]

(33) The value **c'** of the local context defined in (32) is:
      $\mathbf{c'} = \lambda w_s \lambda x_e$ C(w) = 1 and JW(w)(x) = 1

It follows that *Some journalist is a female widow* is predicted to be deviant, as *female* is now entailed by its local context (since **c'** entails the property of being female, and also that of being a journalist).

5.2 *The importance of ignoring non-restrictive modifiers*

It is worth noting that taking into account the possibility that a modifier *F* could be non-restrictive, and thus that the modified denotation (**FW)** is not included in the noun denotation **W**, will derail the computation of local contexts. Types would need to be adjusted to handle such cases: nominal modifiers should now be taken to have (intensionalized version of) type <et, et>. For the sentence *Some journalist is a female widow,* we will need to revise our definition of the local context as follows (with boldfaced changes in types):

(34) In a context C, the local context of *F* in *(Some J . (F W))* is the strongest x **of type <et, et>** which guarantees that for any *M'* **of type <et, et>**,

      C ⊨^{c'→x} (Some J . ((c' and M') W)) ⇔ (Some J . (M' W))

In this modified framework, the adjective *female* has the adjusted lexical entry in (35):[14]

(35) **F^w** = **female^w** = $\lambda f_{<e, t>} \lambda x_e$ f(x) = 1 and x is female in w.

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[12] The equivalence stems from the fact that *Some A B* just checked whether the intersection of **A** and **B** is non-empty. As a result, *(Some J . (W and blah)* has the same meaning as *(Some (J and W). blah)* (in either case, we just check whether the intersection **J** ∩ **W** ∩ **blah** is non-empty.

[13] This can also be proven directly. In view of the fact that the fragment is extensional (= the value of a formula at a word w only depends on the value of its component parts at w), and that *some* is conservative, it is clear that **c'** as defined satisfies (32)b. To prove that this is the strongest value that satisfies this condition, suppose that for some w, x such that C(w) = 1 and **JW**(w)(x) = 1, **c'**(w)(x) = 0. Select an *M'* whose value satisfies **M'**(w) = {x}. It is clear that at w (which is in C), the right-hand side of (32)b is true, as x is in the intersection of **JW** and **M'**, while the left-hand side is false because (**c' and M'**) = ø.

[14] It can be checked that with extensional function application as in fn. 10 (iii), we obtain the desired results, for instance for *female engineer*:

(i) (**female engineer)^w** = **female^w**(**engineer^w**) = [$\lambda f_{<e, t>} \lambda x_e$ f(x) = 1 and x is female in w](**engineer^w**) = λx_e **engineer^w**(x) = 1 and x is female in w]

We would want the definition in (34) to guarantee that the modifier *female* (= *F*) is locally trivial, i.e. entailed by **c'** as defined in (34). But this yields the result that *F* should itself satisfy the equivalence defining *c'*, as is argued in (36).

(36) For all modifier *M'*:
    a. Replacing *M'* in (34) with *(F and M')*, we obtain:
    $C \vDash^{c' \to x}$ (Some J . ((c' and (F and M')) W)) ⇔ <u>(Some J . ((F and M') W))</u>
    b. If the local context **c'** entails **F** (and thus *(c' and F)* is equivalent to *c'*):
    $C \vDash^{c' \to x}$ (Some J . ((c' and F) and M') W) ⇔ (Some J . ((c' and M') W))
                                          ⇔ <u>(Some J . (M' W))</u> (because **c'** is the local context)
    c. It follows that the underlined expressions, which are equivalent to the same left-hand side, are also equivalent to each other:
    $C \vDash$ (Some J . ((F and M') W)) ⇔ (Some J . (M' W))

In other words, if the modifier *female* is locally trivial, we derive the result that for all modifiers *M'*, *some journalist is a [female and M'] widow* should be equivalent to *some journalist is an M' widow*. The problem is that this result couldn't be true when one considers all the possible values of *M'*. For instance, take *M'* = *fake*. In this case, *is a fake widow* has a completely different meaning from *is a [female and fake] widow*, as the latter reduces to *is a female widow and is a fake widow,* which in turn simplifies to *is a widow and is a fake widow*.[15] So in this case the equivalence in (36)c will not hold. Which implies either that (i) our procedure to compute local contexts must somehow ignore the possibility that modifiers might be non-restrictive, or that (ii) our procedure is wrong.
      Within the confines of the present discussion, we conclude that the procedure to conclude local contexts of modifiers must crucially overlook the possibility that some of them are non-restrictive.

6   Integrating 'inside out' with broader theories of local context computation

As things stand, our analysis is incomplete: we haven't explained how we can integrate our definition of the local context of modifiers within general algorithms of local context computation. The problem is non-trivial because the 'inside out' evaluation of NP modifiers doesn't extend to other constituent types, hence at this point different recipes must be employed for different parts of a sentence.

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[15] This follows from the rules in fn. 10. Technically, NP denotations are of type <s, et>, and we take modifiers to be of type <s <et, et>. With the rules of fn. 10, we can derive the following:

(i) If *d* and *d'* are (modifiers) of type <s, <et, et>>,
(d and d')^w = $\lambda f_{<e,t>}$. **d**^{w}(f) and **d'**^{w}(f), by rule (ii) in fn. 10
[= $\lambda f_{<e,t>}$. λx_e. **d**^{w}(f)(x) and **d'**^{w}(f)(x), by rule (i) in fn. 10]

Thus if *female* and *fake* have type <s, <et, et>, and *widow* has type <s, et>, **[female and fake]**^{w} = $\lambda f_{<e,t>}$. **female**^{w}(f) and **fake**^{w}(f), and by extensional function application (= rule (iii) in fn. 10), we have:

(ii) **[[female and fake] widow]**^{w} = **[female and fake]**^{w}(**widow**^{w})
= [$\lambda f_{<e,t>}$. **female**^{w}(f) and **fake**^{w}(f)](**widow**^{w})
= **female**^{w}(**widow**^{w}) and **fake**^{w}(**widow**^{w})
= λx_e. **female**^{w}(**widow**^{w})(x) and **fake**^{w}(**widow**^{w})(x)
= λx_e. **widow**^{w}(x) and **fake**^{w}(**widow**^{w})(x)   (because **female**^{w}(**widow**^{w}) = **widow**^{w})

As a proof of concept, we propose to specify a procedure that takes as input a sentence with a distinguished position (written as _), and returns the set of alternatives that must obey the equivalence in (30), thus yielding the value of the local context of _ . Due to the complexity of the problem, it is important to make things as simple as possible by investigating a tiny fragment (as is done in all studies that seek to reconstruct local contexts in a predictive fashion). We thus start from the fragment in (37), which generates sentences of the form *(p₁ and p₂)*, *(_ and p₂)* (when we wish to assess the local context of _), but also quantified statements with a main predicate *F*, of the form *(Q F)*. Here *Q* stands for a quantified noun phrase of the form *someone, some journalist, every student,* etc. (proper names can also be thought of as special cases of generalized quantifiers)[16]. We do not seek to decompose *Q* further because we will be solely interested in NPs that appear in predicative (i.e. verbal) position. We will also consider modified predicates of the form *(P₁ P₂)*, where *P₂* corresponds to a nominal predicate and *P₁* to its modifier. It is important that nominal modifiers are preposed, as in English and Chinese, because our goal is to determine how 'inside out' (for NPs) and linear-looking orders of evaluation (for conjunction) can be combined when they 'pull' in different directions. For this reason, we will also consider quantified statements of the form *(Q (P₁ P₂))*, where *(P₁ P₂)* is a modified predicate – e.g. *Someone is a female engineer*. We will also consider formulas for the form *(Q (_ P₁))*, e.g. when we wish to assess the local context of an intersective modifier added to *P₁*.

(37) a. *Vocabulary:* we consider a highly simplified fragment with (i) propositional and predicative constants p_i, P_i (ii) unanalyzed quantificational Noun Phrases Q_i, (iii) predicative and propositional conjunctions written as *and*. To specify the position whose local context is computed, the symbol _ is added to the set of propositional and to the set of predicative expressions.
b. *Syntax:*
If f and g are propositional expressions, so is *(f and g)*.
If *F* and *G* are predicative expressions, so are *(F and G)* and *(F G)*
If *F* is a predicative expression, *(Q F)* is a propositional expression.

We then consider a formula with _ in a certain position, e.g. *(_ and p₁)*, and we gradually replace expressions with variables of the same type when the information these expressions provide is not accessible in the computation of the local context. For notational simplicity, we use primed expressions – e.g. *p'₁*, *P'₃* as variables added to our official language to obtain this result, with the same types as the unprimed expressions. In our example, then, the goal is to transform *(_ and p₁)* into *(_ and p'₁)*, thus indicating that the information about the second conjunct is not accessible in the computation of the local context of the first conjunct.

But how can this transformation be achieved in a systematic fashion? We will transform an entire formula step by step. Re-write will be done constituent by constituent, marking an expression with ₘ after it has been treated in the appropriate fashion. In the initial stage, we always have ₘ on _, the position whose local context we are computing. The goal is then to move ₘ to the outermost position in the sentence by way of an iteration of the rewrite rules in (38). Importantly, these rules are just the compact specification of a useful algorithm; they have nothing to do with rules used in syntax to indicate how constituents are generated.

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[16] In generalized quantifier theory, *Sam* can be given a quantifier type <et, t>. If s is the individual denoted by *Sam*, the generalized quantifier value of the proper name can be defined as: **Sam**ʷ = λf$_{<e, t>}$. f(s) = 1.

(38) Permissible transformations (we use lowercase letters for propositional expressions and uppercase letters for predicative expressions, and expressions like g', G' for 'fresh' propositional or predicative variables, e.g. p_1', P_1')

1. $(f_m \text{ and } g) \rightarrow (f \text{ and } g')_m$

2. $(f \text{ and } g_m) \rightarrow (f \text{ and } g)_m$

3. $(F_m \text{ and } G) \rightarrow (F \text{ and } G')_m$

4. $(F \text{ and } G_m) \rightarrow (F \text{ and } G)_m$

5. $(F_m \text{ } G) \rightarrow (F \text{ } G)_m$

6. $(F \text{ } G_m) \rightarrow (F' \text{ } G)_m$

7. $(Q \text{ } G_m) \rightarrow (Q \text{ } G)_m$

The boldfaced rules in (38)3,5,6 require a comment. First, despite the similarities in their semantics, predicate conjunction and predicate modification don't have the same rewrite effects: (38)3 specifies that the first conjunct doesn't have access to information in the second, while (38)5 specifies that a preposed predicate modifier *does* have access to the predicate it modifies. Second, (38)6 specifies that a predicate *G* modified by a preposed predicate *F* does *not* have access to the value of *F*, which is essential to account for the acceptability of *a pregnant woman*, for instance.

     The procedure then works as follows. We start from a sentence with a distinguished position $\_m$ to indicate which local context we are computing. We then gradually replace the necessary expressions with variables, moving the $_m$ around in accordance with the rules in (38). To facilitate cross-reference to relevant rules in derivations, we superscript $\rightarrow$ with a number corresponding to the rule from (38) which is invoked (e.g. $\rightarrow^3$ indicates that the rewrite is permitted by rule (38)3). When the $_m$ is in outermost position, we use the formula (without $_m$) to tell us which alternatives must satisfy the equivalence in (30).[17]

     Crucial cases are derived in (39). To illustrate, it might help to say in words what (39)a does. It seeks to compute the local context of the first conjunction, marked as $\_$, in a formula *($\_$ and p_1)*. It does so by starting with a version of the formula with the position $\_$ marked with $_m$, hence: *($\_m$ and p_1)*. Then it pushes $_m$ to the outermost position by rewriting this formula as *($\_$ and p_1')$_m$* thanks to rule (38)1. Replacing the distinguished position $\_$ with d' or with *(c' and d')*, we finally require that the local context **c'** should be the strongest value x which, for all appropriate d' and p_1', satisfies relative to C the equivalence: *((c' and d') and p_1') $\Leftrightarrow$ (d' and p_1')*.

(39) a. $(\_m \text{ and } p_1) \rightarrow^1 (\_ \text{ and } p_1')_m$ and thus we require that for all d', p_1',
$C \vDash^{c' \rightarrow x} ((c' \text{ and } d') \text{ and } p_1') \Leftrightarrow (d' \text{ and } p_1')$.

  b. $(Q \text{ } (\_m \text{ } P_2)) \rightarrow^5 (Q \text{ } (\_ \text{ } P_2)_m) \rightarrow^7 (Q \text{ } (\_P_2))_m$, hence to compute the local context of a modifier of P_2 we will require that for all d',
$C \vDash^{c' \rightarrow x} (Q \text{ } ((c' \text{ and } d') \text{ } P_2)) \Leftrightarrow (Q \text{ } (d' \text{ } P_2))$

  c. The same result is obtained if P_2 is replaced with a modified Noun Phrase $P_3(P_2)$: the final condition will ensure that the local context of a further modifier, starting from *(Q ($\_m$ $P_3(P_2)$))*, is computed in a way that ensures access to both innermost predicates, thanks to the equivalence:

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[17] More formally: If *(… d …)* is a sentence of the fragment in (37), and if *(… $\_m$ …)* can be rewritten into another formula *(••• $\_$ •••)$_m$* in accordance with (38), with (primed, lowercase or uppercase) variables $v'_1…v'_n$, the local context of *d* in *(… d …)* relative to a context C is the strongest proposition or property x which guarantees that for all d' of the same type as *d*, for all expressions $v'_1…v'_n$ (of the appropriate types):

$C \vDash^{c' \rightarrow x} (•••(c' \text{ and } d') •••) \Leftrightarrow (••• d' •••)$

$C \models^{c' \to x} (Q ((c' \text{ and } d')(P_3 P_2))) \Leftrightarrow (Q (d' (P_3 P_2)))$

d. By contrast, the local context of a modified Noun Phrase P_2 in $P_1 P_2$ does not have access to the value of the modifier:
$(Q (P_1 \_\_m)) \to^6 (Q (P_1' \_\_)_m) \to^7 (Q (P_1' \_\_))_m$, and we will require that for all d', P_1',
$C \models^{c' \to x} (Q (P_1' (c' \text{ and } d'))) \Leftrightarrow (Q (P_1' d'))$

e. When we compute the local context of a modifier in a first conjunct, we take into account part of the information that linearly follows, namely that pertaining to the modifie Noun Phrase, but we don't take into account the second conjunct:
$((Q (\_\_m P_2)) \text{ and } p_1) \to^5 ((Q (\_\_ P_2)_m) \text{ and } p_1) \to^7 ((Q (\_\_P_2))_m \text{ and } p_1) \to^3 ((Q (\_\_P_2)) \text{ and } p_1')_m$, hence a requirement that for all d', p_1',
$C \models^{c' \to x} ((Q ((c' \text{ and } d') P_2)) \text{ and } p_1') \Leftrightarrow ((Q (d' P_2)) \text{ and } p_1')$

f. When a conjunction *(P₁ and P₂)* modifies a Noun Phrase P_3 in the structure *((P₁ and P₂) P₃)*, the local context of P_1 has access to P_3 but not to P_2:
$(Q ((\_\_m \text{ and } P_2) P_3)) \to^1 (Q ((\_\_ \text{ and } P_2')_m P_3)) \to^5 (Q ((\_\_\text{and } P_2') P_3)_m) \to^7 (Q ((\_\_\text{and } P_2') P_3))_m$, hence a requirement that for all d', P_2',
$C \models^{c' \to x} (Q (((c' \text{ and } d') \text{ and } P_2') P_3)) \Leftrightarrow (Q ((d' \text{ and } P_2') P_3))$

g. On the other hand, in the same structure *((P₁ and P₂) P₃)*, the local context of P_2 has access to both P_3 and P_1:
$(Q ((P_1 \text{ and } \_\_m) P_3)) \to^2 (Q ((P_1 \text{ and } \_\_)_m P_3)) \to^5 (Q ((P_1 \text{ and } \_\_) P_3)_m) \to^7 (Q ((P_1 \text{ and } \_\_) P_3))_m$, hence a requirement that for all d',
$C \models^{c' \to x} (Q ((P_1 \text{ and } (c' \text{ and } d')) P_3)) \Leftrightarrow (Q ((P_1 \text{ and } d') P_3))$

Examples (39)a-d are unsurprising since they just encode old or new generalizations: the second conjunct isn't accessed in the computation of the local context of the first conjunct (= (39)a); the local context of a higher preposed modifier has access a lower noun or noun phrase (= (39)b,c); and the local context of a noun doesn't have acess to preposed modifiers (= (39)d).

(39)e highlights the interplay between different notions of order: in computing the local context of the modifier embedded in the first conjunct, we have access to the modified Noun Phrase but not to the second conjunct, although both follow the modifier. (39)f,g present new benefits of the analysis: the system correctly predicts that in a modified Noun Phrase of the form *((P₁ and P₂) P₃)*, the local context of P_2 has access to P_1 and P_3, whereas the local context of P_1 has access to P_3 but not to P_2, despite the fact that both appear to its right. This seems correct in view of the data discussed in (14)-(15) and (16)-(17), e.g. the following (= (14)a,b and (16)a,b respectively).[18]

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[18] We also predict that reversing the order of the conjunctions in (14) should yield related contrasts. One consultant helpfully re-rated (14) and provided comparative judgments with (i). Contrasts go in the same direction: (14)a,b,c,d are rated as 6, 2, 7, 7, while with the order of the conjuncts reversed as in (i), ratings are 5, 1, 7, 7.

(i)   Under Nazi occupation, this heroic family hid…
a. [5] a dark-skinned and Hasidic French Jew.
b. [1] a dark-skinned and Jewish French Hasid.
c. [7] a dark-skinned and Hasidic French child.
d. [7] a dark-skinned and Jewish French child.

(40) Under Nazi occupation, this heroic family hid…
    a. [7] a Hasidic and dark-skinned French Jew.
    b. [2.2] a Jewish and dark-skinned French Hasid.

(41) Under Nazi occupation, this heroic family hid…
    a. [4.8] a female and pregnant French refugee.
    b. [2.7] a pregnant and female French refugee.

       In sum, we have provided a 'proof of concept' for a procedure that integrates the 'insider out' order of evaluation for NP modifiers with linear-looking orders for conjunctions. We had to provide this integration cause as things stand no more general notion of order appears to work for both construction types – a situation that ought to be remedied in the future.

7   Consequences and open questions

7.1   *Consequences for theories of update order*

If the 'inside out' theory of modifier update is correct, extent proposals about update order must be refined. The following theories have been entertained in the literature.

(i) Linear accounts: for these, local contexts take into account linearly earlier expressions. This was refuted for nominal modifiers by Ingason 2016; the present findings confirm his conclusions.

(ii) C-command-based accounts: Ingason 2016 proposed that "structurally higher elements are entered into the context before lower elements". Romoli and Mandelkern 2017 proposed something similar on the basis of update order in conditionals, where *if*-clauses are evaluated before main clauses whether they are linearly positioned before or after them. But 'higher is earlier' seems to make entirely incorrect predictions in the present case.

(iii) M-command based accounts: Chierchia 2010 proposed an alternative structural account, one in which co-arguments of a functor are taken into account in order of structural proximity to that functor. So in a structure *[f A] B*, where *f* is the functor and *A, B* are its arguments, *A* is structurally closer to *f* than to *f* of *B* is (technically: *A* m-commands *B*[19]), and for this reason the local context of *A* doesn't take into account *B* but the local context of *B* does take into account *A*. If the modified nominal were a functor, the 'inside out' generalization would follow, at least when it comes to the update order of modifiers relative to each other. But a noun of type <e, t> couldn't be the 'functor' for its modifiers. If anything, when one considers a broader class of modifiers including non-intersective ones (e.g. *competent, fake*), the modifiers must be given type <et, et> (or intensionalized versions thereof). If so, in a structure *M' [M N]*, where *M* and *M'* are of type <et, et> whereas *N* is of type <e, t>, *M'* is a functor, but it's not the case that *M* and *N* are co-arguments of *M'*. Rather, *M'* takes a single argument, *MN*. Nothing yields the result that the update order is *N* before *M* before *M'*.

(iv) Linear bias with domain-by-domain interpretation: Chung 2019 proposes that "the interpreter parses a sentence from left to right, but the local context of an expression (either propositional or predicative) can be calculated only at points where the interpreter has access to the semantic values of the parsed expressions". For him, semantic values

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[19] Chierchia 2010 relies on the following definition: "If A and B are co-arguments of f, A f-commands B iff the first functional complex f(A) containing A does not contain B. (= A is closer to f than B)"

must be propositional, and thus "the interpreter needs to postpone the calculation of local context if the parsed expressions altogether do not constitute a clause". It is immediate that this account won't extend to our data: none of the expressions we study (adjectives and nouns) are of propositional type, and thus one would expect that the modifiers and the head noun are all evaluated at once, since no propositional expression can be obtained without including them all.[20]

7.2 Open questions

This note leaves open several questions.

(i) We restricted attention to intersective nominal modifiers. But as mentioned in Section 5.2, a somewhat paradoxical result is obtained when non-restrictive modifiers such as *fake* are taken into account: the local contexts obtained fail to derive the triviality effects we find.

(ii) One would like to extend the empirical and theoretical investigation to other types of modifiers (e.g. clausal modifiers, verbal modifiers) – something we leave for future research.

(iii) Assuming that 'inside out' is correct, how can it be married with update algorithms for other constructions? We have sketched an integration mechanism that yields positive results in some cases, but its properties have yet to be evaluated.

(iv) A more traditional analysis within dynamic semantics ought to be compared to the present one. This is particularly important because the absence of a general theory of update order within non-dynamic accounts threatens their explanatory force, bringing them a tad closer to the explanatory problems faced by dynamic semantics.[21]

(v) Last, but not least, one needs to explain *why* the 'inside out' generalization holds. This is intimately related to the problem of finding a general algorithm that accounts for diverse constructions, since the test of any theory will in part lie in its generality.

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[20] One connection with other research should be added. Scontras et al. 2019 argue that constraints on adjectival ordering can be given a pragmatic derivation. Instead of following Cinque's (2010) heavily syntactic analysis, they go with a generalization consonant with Scontras et al. 2017, to the effect that less 'subjective' adjectives prefer to be hierarchically closer to the head noun. They show that this generalization can be derived from a drive to restrict reference space: having the more error-prone adjectives later in the computation minimizes risk of referential identification. Crucially, however, this analysis relies on a notion of computation order. The authors take as a given that this should be order of semantic composition, but at least for intersective adjectives, any other order would yield the same semantic effect. It is thus interesting to note that the 'inside out' order derived here is exactly the one that the authors need to get their account to work.

[21] See for instance Rothschild 2011 and Schlenker 2009 (Section 3.2) for ways to constrain dynamic semantics.

Supplementary Materials: raw data for the mini-survey of English

Text of the survey:
https://drive.google.com/file/d/1MT24fswFdBR0zYNOM0vYfDKXd8z4EWLb

Responses (6 linguists who are native speakers of American English):
https://drive.google.com/file/d/10_-CrAC_FtZbx9PvA41ulltORrPixdkQ

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