2

Features on Bound Pronouns

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Are person, number, and gender features on bound-variable pronouns semantically interpreted, or are they just a superficial reflex of agreement between the pronoun and its antecedent? Some have argued that at least some pronouns have the semantics of featureless, unrestricted, variables. Others have pointed out good predictions from the assumption that features on bound pronouns restrict the range of the relevant variable. It has also been suggested in recent work that simple deletion or copying rules such as those proposed in the literature do not quite succeed in predicting the distribution of features on bound pronouns. I will review the case for uninterpreted features and explore some of the challenges involved in improving on existing accounts. Data about plural pronouns with split antecedents will play an important role.

2.1 Phi-features as presupposition triggers

Before we debate whether features on bound pronouns are semantically interpreted, we must agree on how they would be interpreted if they were. Uncontroversially, *some* occurrences of pronoun features are interpreted, notably those on deictic pronouns. Let us make precise what their interpretation in these uncontroversial cases is, so we know what the facts would be like if features on bound pronouns were interpreted likewise.

2.1.1 *Features on deictic pronouns*

The features we are concerned with are the so-called "φ-features": person, number, and gender. Semanticists that have attended to them have generally given them a presuppositional semantics, as pioneered by Cooper (1983) for English gender. In the implementation of Heim and Kratzer (1998), this looks as follows. In the syntax (LF), each pronoun has a numerical index. Indices are variables and mapped to semantic values by an assignment. For free pronouns,

the relevant assignment is given by the utterance context and represents the speaker's referential intentions. When φ-features are disregarded, the index is the only semantically interpreted part of the pronoun, and the pronoun is simply a variable, as reflected in rules like (1).

(1) If β is a pronoun and i an index, then for any assignment g, $[\![\beta_i]\!]^g = g(i)$ (or undefined, if i is not in the domain of g).

If one or more φ-features are present, these are adjoined to the indexed node (in an arbitrary hierarchical order).

(2) [3rd [singular [masculine [he_7]]]]

Each feature denotes a partial identity function of type ⟨e,e⟩. For gender, these are:

(3) $[\![\textbf{masculine}]\!] = \lambda x_e$: x is male. x
$[\![\textbf{feminine}]\!] = \lambda x_e$: x is female. x

The constituent consisting of the feature and its complement is interpreted by Functional Application. It denotes an individual only if the denotation of the complement happens to have the relevant property (maleness or femaleness). When it does denote, it denotes the same individual. The partiality of the interpretation function is inherited up the tree and ultimately induces truth-value gaps for the containing sentence. In a simplified example (omitting person and number), we compute the following result.

(4) For any g: $[\![$**MASC-he$_7$ is married**$]\!]^g$ is defined if $7 \in$ dom(g) and g(7) is male.
Where defined, $[\![$**MASC-he$_7$ is married**$]\!]^g = 1$ if g(7) is married, and = 0 otherwise.

If we are dealing with an unembedded occurrence of this sentence, uttered by a speaker who intends the 7th variable to refer to John, this means that the speaker is presupposing John to be male and asserting him to be married.

This is Cooper's treatment of gender features, and it can be extended straightforwardly to person and number[1] (notwithstanding the prevailing tradition in philosophy to analyze first person pronouns as indexicals rather than variables). We can treat all pronouns, regardless of person and number, as variables, hence subscripted by a numerical index and interpreted by rule (1). The various features attached to this index all denote partial identity functions. For number features, we need an ontology that has pluralities as well as simple objects among its individuals and supports appropriate notions

[1] See, e.g., Dowty and Jacobson (1989), Schlenker (2002), Sauerland (2003).

of atomicity and inclusion. Person features happen to be indexicals,[2] that is, they denote functions defined with reference to an utterance context that determines participant roles such as speaker and addressee.[3] I use "s_c", "h_c" as abbreviations for "the speaker (addressee) of c."

(5) number: $[\![\textbf{singular}]\!] = \lambda x_e$: x is an atom. x
$[\![\textbf{plural}]\!] = \lambda x_e$: x is a plurality. x

person: $[\![\textbf{1st}]\!]^c = \lambda x_e$: x includes s_c. x
$[\![\textbf{2nd}]\!]^c = \lambda x_e$: x includes h_c and excludes s_c. x
$[\![\textbf{3rd}]\!]^c = \lambda x_e$: x excludes s_c and h_c. x

For a first person singular pronoun, we compute the following presupposition and assertion.

(6) LF: $\textbf{I}_7$ **am married**, spoken in a context c,
asserts that $g_c(7)$ is married, and
presupposes that $g_c(7)$ is an atom including s_c.

Given the background ontology, an atom that includes the speaker can only be the speaker himself. So if the speaker of (6) manifestly intends to refer with *I* to himself, the presupposition in (6) is (trivially) true. If he manifestly intended to refer to someone else, it would be obviously false. Since it is impossible to presuppose an obvious falsehood, this cannot happen. Thus *I* always refers to the speaker, despite being technically a variable.

2.1.2 *Features on bound-variable pronouns*

We have seen how φ-features on deictic pronouns, via their presuppositions, constrain the range of possible referents. Turning now to anaphoric, and specifically bound-variable, pronouns, it is not immediately obvious that the role of φ-features is the same. Reference, after all, is beside the point here, and the most salient job that φ-features appear to be performing is to constrain the range of possible *antecedents*. This is reflected in the grammaticality contrasts we obtain by varying φ-features of an obligatorily anaphoric pronoun such as the English *self*-reflexive.

(7) Mary invited herself/*himself/*myself/*themselves.

From a theoretical point of view, it would be disappointing to have different analyses of the same features depending on whether they are on deictic or anaphoric pronouns. And as we are about to see, there is good reason to

[2] Notice that this is not the same thing as treating the pronoun itself as an indexical.
[3] See, e.g., Zwicky (1977) and Noyer (1992) for analyses of the morphosemantics of person.

believe that this undesirable maneuver is also unnecessary. The antecedent-constraining role of φ-features on anaphoric pronouns will be seen as a side-effect of their basic reference-constraining semantics.[4]

The LF of one of the ungrammatical versions of (7) must display the co-indexing in (8) to satisfy Binding Theory.

(8) Mary 5[t_5 invited MASC_5]

What happens in the semantics? We first derive that the open sentence t_5 *invited* $MASC_5$ denotes a truth value only under those assignments that map 5 to a male. Next we apply Predicate Abstraction, which in a system with truth-value gaps is naturally formulated as follows.[5]

(9) $[\![\mathbf{i}\ \alpha]\!]^g = \lambda x_e\colon \alpha \in \text{dom}([\![\ ]\!]^{gx/i}).\ [\![\alpha]\!]^{gx/i}$

The predicate $5[t_5$ *invited* $masc_5]$ in (8) then denotes the partial function whose domain is males and which maps those who invited themselves to 1 and the others to 0 (in symbols, [λx_e: x is male. x invited x]). In the final step, we apply this function to Mary, which is only possible if Mary is male. So we predict that (8) presupposes that Mary is male. The asterisk in (7) reflects the judgment that "Mary invited himself" is deviant under normal assumptions, namely when (the relevant) Mary is assumed to be a female. To the extent that the possibility of "Mary" naming a man is considered, the deviance judgment is qualified—as we predict.

We saw already in this simple example that when we apply our presuppositional treatment of φ-features to bound-variable pronouns, we must complement it with a suitable theory of "presupposition projection". In our setting, this amounts to formulating composition rules and lexical entries so they handle partiality in their inputs and pass it up appropriately to their outputs. Specifically, we need the formulation of Predicate Abstraction in (9), and—as we will see next—the right lexical entries for quantifying determiners. Consider a quantified variant of (7).

(10) a. *Every girl invited himself.

b. LF: every girl 5[t_5 invited masc_5]

To interpret this, we must know how the generalized quantifier **every girl** applies to the partial function denoted by its sister. An appropriate entry is (11), predicting for (10a) the presupposition that every girl is male.

[4] This is the main point of Cooper's chapter on "Gender agreement" (ch. 7 of Cooper 1983). Dowty & Jacobson (1989) push Cooper's approach further by considering number and person and by applying it also to the agreement between subjects and verbs.

[5] See Heim and Kratzer (1998), where this formulation is motivated by examples of definite descriptions inside relative clauses.

(11) $[\![\textbf{every}]\!] = \lambda f_{\langle e,t\rangle}.\ \lambda g_{\langle e,t\rangle}$: $\{x: f(x) = 1\} \subseteq \mathrm{dom}(g).\ \{x: f(x) = 1\} \subseteq \{x: g(x) = 1\}$

Again, this corresponds to the relevant judgment about (10): a deviant utterance under normal assumptions about the world.

A consequence of this approach (highlighted by Cooper) is that common nouns need not be marked for gender. For example, the explanation just given for the deviance of (10) did not rely on the assumption that the noun *girl* was feminine—only on the assumption that girls are female.[6] This helps account for nouns that can antecede pronouns of either gender. Both (12) and (13) are non-deviant, but one is appropriate if the class is all male and the other if it is all female.

(12) Every student in my class voted for himself.

(13) Every student in my class voted for herself.

We derive this from the assumptions we used in the analysis of (10). Example (12) presupposes that every student in my class is male, and (13) that every one is female.

Cooper's way of capturing gender mismatches between a bound pronoun and its binder as presupposition failures can also be applied to person and number mismatches. We derive impossible presuppositions also for (14) and (15).

(14) *Every girl voted for themselves.
LF: every girl 5[t_5 voted for 3rd-pl_5]
predicted presupposition: "every girl is a plurality"

(15) *Every girl voted for myself.
LF: every girl 5[t_5 voted for 1st-sg_5]
predicted presupposition: "every girl is identical to s_c"[7]

A worry may arise of how the account applies to the non-quantified version of (15), which is no better.

(16) *Mary invited myself.
LF: Mary 5[t_5 invited sg-$1st_5$]
predicted presupposition: "Mary = s_c"

[6] On extending this analysis to non-natural gender, see Cooper (1983), Dowty and Jacobson (1989), Pollard and Sag (1994).

[7] I take it that the domain of *every* cannot be a singleton, as a matter of a presupposition or other felicity condition imposed by *every*. Given this, the predicted presupposition is impossible.

This presupposition is not impossible, since (16) might be spoken by Mary herself. I suggest that it is deviant for an independent reason, a general prohibition against referring to oneself by one's name.[8]

2.1.3 *Features on "split bound" plural pronouns*

Schlenker (2002) points out that the presuppositional analysis of φ-features also applies successfully to cases of plural pronouns with so-called split antecedents. Non-deictic plural pronouns sometimes seem to get their reference from two or more separate antecedents at once. For example, *they* in (17) may mean *John and Mary*.

(17) John told Mary that they should get together.

This particular example may not be interesting, since the pronoun can be analyzed as referential. Variations on it, however, have quantifiers in place of one or both of the antecedents, and there the plural pronoun can be neither a free nor a bound variable.

(18) Every boy told Mary that they should get together.

Example (18) can mean that each boy x told Mary that x and Mary should get together. If *they* were a free variable, it would have to pick out a fixed plurality not dependent on x, and if it were a bound variable, it would be coindexed with the trace of one of the higher DPs. Neither way could its value vary with, yet be different from, the value of the variable bound by *every boy*. In order to capture the intended reading, we must represent this plural pronoun as a *coordination of two variables* (one bound by *every boy*, the other either free or bound by *Mary*).

(19) every boy 7[t_7 told Mary that 3rd-pl_{7+8} should get together]
where $g_c = [8 \rightarrow \text{Mary}]$

Previous authors who have drawn this conclusion have used notations such as $they_{7,8}$ or $they_{\{7,8\}}$, assuming the same semantics.

(20) If β is a pronoun and i, j are indices, then for any assignment g,
$[\![\beta_{i+j}]\!]^g = g(i) \oplus g(j)$ (the i-sum of g(i) and g(j)).

[8] This isn't the whole story. In certain registers one does refer to oneself by name, yet even in those, (16) is not allowed (though *Mary invited herself* is). A conceivable explanation invokes two assumptions: First, these special registers are languages in which there is no first person. (So (16) is just not a sentence.) Second, third person in those languages does not trigger any presupposition. (As we will note in Section 2.1.4 below, there is reason to assume that third person doesn't carry a semantic presupposition even in the standard language. Still, there is a difference: In the standard language, *third* competes with *first* and therefore gives rise to an implicated presupposition, whereas in the special register there is not even that.)

I call such readings of plural pronouns "split bound" readings.

Let's look at the pronoun's features now, in this case third person plural. As before, we represent the features as adjoined at the edge of the pronoun, so they here apply to the semantic value of the whole complex index. The presupposition that we generate for (19) then is (21).

(21) for every boy x, x ⊕ Mary is a plurality not including speaker or hearer

This is an obvious truth, at least in normal contexts for the use of this sentence, where the boys under discussion include neither Mary nor the speaker or hearer.[9] If we tried to substitute a singular feature for the plural feature in this LF, we would presuppose a necessary falsehood, and likewise if we substituted a first or second person feature. So we explain why the reading under consideration requires a plural third person pronoun.

Split-bound readings also occur in first (and second) person plural pronouns, as first pointed out by Partee (1989) and discussed further by Schlenker (2002) and Rullmann (2004). One of Rullmann's examples is (22), with our analysis of its intended reading.

(22) Every woman I date wants us to get married.
LF: every woman 2[1st-sg$_3$ date t$_2$] 4[t$_4$ wants 1st-pl$_{3+4}$ to get married]
$g_c = [3 \rightarrow \text{speaker}_c]$
predicted assertion: for every woman x, x wants x ⊕ s_c to get married
predicted presupposition: for every woman x, x ⊕ s_c is a plurality including s_c

The predicted presupposition again is an obvious truth, and we can see that no other choice of number or person feature would have yielded coherent presuppositions.

2.1.4 *Refinement: semantic presuppositions and implicated presuppositions*

The astute reader may have noticed some predictions that aren't quite right, specifically with regard to bound variable pronouns in the third person. Consider (23).

(23) Every girl invited herself.
LF: every girl 5[t$_5$ invited 3rd-sg-fem$_5$]

With our entry for the third person feature and our assumptions about presupposition projection, we predict that this sentence can only be used to talk about a set of girls that does not include the speaker or hearer. This seems too

[9] I get back to this caveat shortly.

restrictive. It is not impossible that (23) might be uttered by, or addressed to, a member of the same set of the girls that are being talked about. A continuation like "including me (and you)" does not sound infelicitous.

The problem is real, but admits of a solution entirely compatible with the general approach under consideration. The solution is Sauerland's distinction between semantic presuppositions and implicated presuppositions. Sauerland (2003, this volume) proposes that *3rd* does not have the entry in (5), but rather denotes the unrestricted identity function (i.e., it triggers no semantic presupposition). However, there is a principle "Maximize Presupposition" which says that a speaker must always choose the person feature with the strongest presupposition he can felicitously make. So a speaker must not use he_i to refer to himself, since he could use I_i instead and thereby express the presupposition that $g_c(i)$ includes s_c. Put differently, the choice of he_i over I_i gives rise to an "implicated presupposition" that $g_c(i)$ does not include s_c. Similarly, the choice of he_i over you_i implicates the presupposition that $g_c(i)$ does not include h_c. What was previously encoded as semantic presuppositions of the third-person feature are accounted for as implicated presuppositions.

In many cases, this reanalysis does not make any difference in empirical predictions, but it does when it comes to third person *bound* pronouns like that in (23).[10] In this case, the implicated presupposition is substantially weaker than the semantic presupposition we predicted originally. By not using a first or second person pronoun instead of *herself* in (23), the speaker merely implicates that she cannot presuppose that every girl includes s_c or that every girl includes h_c. This does not rule out that one of the girls is the speaker or the hearer, and thus it brings our predictions closer to the intuitive facts. The same amendment applies to the analysis of our split-bound example (18). We no longer predict a semantic presupposition that for no boy x does x $\oplus$ Mary include the speaker or hearer, but a weaker implicated presupposition that neither s_c nor h_c is part of x $\oplus$ Mary for *every* boy x. This is compatible with the boys including the speaker or hearer or both, it just doesn't allow that there's just one boy and he is s_c or h_c.

A closer look at split-bound examples brings up another questionable prediction of our initial analysis, this one concerning not person but number. Change (18)/(19) slightly to replace "Mary" by "John", a name that might refer to one of the boys. The predicted presupposition then is that x $\oplus$ John is a plurality for every boy x, that is, that John is not one of the (relevant) boys. But this should not really be part of the meaning. It's not impossible for John

[10] Sauerland (2003) explicitly exempts bound variable pronouns from his discussion (for reasons that we will get to). His arguments in support of his proposal are independent of my use of it here.

to tell himself "we should get together". Again, a reanalysis of the presupposition as implicated rather than semantic—also argued for on independent grounds by Sauerland—is helpful. If plural triggers no non-trivial semantic presupposition, but competes with singular under Maximize Presupposition, we derive an implicated presupposition that is suitably weaker: not for every boy x is x ⊕ John an atom. This allows John to be among the boys, as long as he's not the only one.[11]

So we want to revise our initial claims about the presuppositional semantics of the φ-features along the lines of Sauerland's theory. This does not threaten the larger project of giving a unified analysis of φ-features on free and bound pronouns. In fact, everything we have seen so far suggests that this project is fundamentally on the right track and provides an appealing explanation of why bound-variable pronouns have to agree in features with their antecedents. But there is more to come.

2.2 Bound-variable pronouns with uninterpreted features

2.2.1 *Bound first person singular pronouns*

Can a first person singular pronoun such as *I*, *me*, *myself* ever be a bound-variable pronoun? Our story so far predicts it can, but we could not possibly distinguish such a reading from a referential one. Given that all pronouns are variables, we can generate LFs in which a first person singular pronoun is a bound variable. Yet its features will ensure that this variable can take on only one value (s_c). As a result, a bound first person singular pronoun can't ever have a truly quantificational antecedent (like a universal or existential quantifier with a non-singleton restrictor), because then there would be the presupposition—impossible for a non-singleton—that each element of the restrictor is identical to s_c.

Some have implied that *I* indeed never acts as a bound variable, so this may look like a good prediction. However, a number of authors, starting with Partee (1989), have pointed to facts that contradict it. A common example is (24), where the relevant pronoun is *my*.[12]

(24) Only I did my homework.

[11] We still correctly rule out *Every girl voted for themselves*, since here even the weaker implicated presupposition ("not every girl is an atom") is incoherent.

[12] Partee's original example is (i).

(i) I'm the only one around here who will admit that I could be wrong.

This example raises special issues which unfortunately are beyond the scope of the present paper. I will only mention two observations that set (i) apart from (24) in the text and the other examples I will treat here: First, the relevant "sloppy" reading in (i) is possible with either first person or third person morphology (whereas in (24), the reading completely disappears if we change *my* to *his* or *her*; see

This can be taken to deny that people other than me did their own homework, that is, to mean "for every x ≠ me, x didn't do x's homework." Obviously this reading is not obtained if *my* is construed as a free pronoun. But (less obviously) it is also not obtained, on our assumptions, if *my* is bound. Binding *my* will give us an LF such as (25).[13]

(25) [only 1st-sg$_1$] 2[t$_2$ did 1st-sg$_2$'s homework]

Given how the presuppositions triggered by *my* project, the predicate abstract 2[t$_2$ did 1st-sg$_2$'s homework] comes to denote the partial function [λx: x = s$_c$. x did x's homework]. This has a singleton domain and cannot be applied to anyone other than s$_c$. We have not specified an explicit semantics for *only* that negotiates partiality in its arguments, but it is easy to see that no possible entry could work here. Suppose the speaker and John are the only relevant people. Then if s$_c$ did s$_c$'s homework and John didn't do John's, (24) is judged true, whereas if s$_c$ did s$_c$'s and John did John's, it's judged false. But the predicate abstract's denotation is the same in either scenario (the singleton {⟨s$_c$,1⟩}). There is no compositional way to get different truth values for the sentence, however we define *only*.

What this example has been taken to show is that φ-features on bound-variable pronouns are not, or not always, interpreted. Perhaps the semantics can somehow ignore them, or the syntax operates in such a way that they are not even there at LF. (We will get into more detail on this.) It is plain how such an assumption helps. If the LF can be (26) instead of (25), the predicate abstract will denote an unrestricted function, and an obvious entry for *only* such as (27) will deliver correct truth conditions. (Empty-set symbols represent pronouns without φ-features.)

(26) [only 1st-sg$_1$] 2[t$_2$ did Ø$_2$'s homework]

(27) $[\![\text{only}]\!] = \lambda x_e.\ \lambda f_{\langle e,t\rangle}.\ \{y\colon f(y) = 1\} = \{x\}$

There is a second problem for us here. The first problem, we just saw, is that (24) has a reading which we predict it cannot have. The flip-side problem is that the following variant of the sentence does not have this reading. Yet (as we will see) we do not rule it out.

(28) Only I did his homework.
cannot mean: "I did my homework, and no-one else did theirs."

below). Second, the sloppy reading in (i) seems to be more narrowly confined to English than that of examples like (24).

[13] This discussion assumes that *only I* is a constituent and the meaning of *only* maps an individual to a generalized quantifier. It is worth noting, however, that we would arrive at essentially the same conclusion if we assumed an analysis of *only* as an essentially proposition-level operator that associates with focus.

Assume that the relevant individuals are again the speaker and John, and both are male. Then consider this potential LF.

(29) [only 1st-sg$_1$] 2[t$_2$ did 3rd-sg-masc$_2$'s homework]

Given the Sauerland treatment of third person, the predicate abstract in (29) denotes a function that is not restricted to non-speakers. It is restricted to atoms and (presumably) to males,[14] but that doesn't exclude either one of the alternatives that *only* quantifies over. There is no obvious way to block this LF as semantically deviant. We don't want to renege on Sauerland's analysis, because then we would be back to predicting that *Every student did his homework* can't talk about a domain that includes the speaker. In fact, the comparison between this example and (28) highlights our dilemma. An even closer minimal pair is (28) and *No student but me did his homework*. In a given context, the students that are relevant for the interpretation of *every student* or *no student but me* and the alternatives that are relevant for the interpretation of *only I* might be exactly the same set (some set of students that includes the male speaker along with other male students). Yet, a third person pronoun can be a variable ranging over this set in the sentences with *every* or *no*, but not in the sentence with *only*.

So we have an undergeneration problem with the grammatical sloppy reading in (24), and an overgeneration problem with an ungrammatical bound reading for (28).

2.2.2 *The broader phenomenon*

In discussing (24), we did not consider the features first person and singular separately, nor have we looked so far at other features. By suitable variations on the example sentence and on the scenarios, we can convince ourselves that the problem is quite general: all φ-features, or at least all those with non-trivial semantic presuppositions, can sometimes be left uninterpreted when they appear on a pronoun bound by an *only*-DP. Moreover, the same phenomenon is observed when the exclusive particle *only* is replaced by a scalar or additive particle like *even* and *also* (here we consider the presuppositions that these items trigger rather than the assertion). The phenomenon replicates itself also in the distribution of sloppy readings under ellipsis.

(30) Johnny did his homework, but I didn't ~~*do my homework*~~.

[14] I have not gone into the question of whether the presupposition of the masculine feature might also be a mere implicated presupposition rather than a semantic presupposition. The problem under consideration can only get worse if this is the case.

A different class of examples in which the morphology of a bound pronoun is at odds with its semantics involves distributive quantification by means of a plural quantificational DP, a floated quantifier, or an implicit distributor.[15]

(31) All candidates think they will win.

(32) These candidates all/each/both/Ø think they are better than all their competitors.

(33) They each believe they are the only person in the room.[16]

The point about these is that the bound-variable pronoun *they* or *their*, despite its plural morphology, must range over atomic individuals. For example, (33) is true if every atom in the plurality denoted by the matrix subject is in the set {x: x thinks x is the only person in the room}. It is not necessary for the truth of (33) that any plurality be in this set, that is, that any plurality think that that plurality is the only person in the room. This indicates that we don't want an interpretation of the bound pronoun *they* that forces its values to be non-atoms.

On our initial interpretation of plural, with a semantic presupposition of non-atomicity, this immediately implies that we can't have an LF like (34) with an interpreted plural feature, since it would presuppose that each atom in $g_c(2)$ is a non-atom.

(34) 3rd-pl$_2$ each 4[t$_4$ think 3rd-pl$_4$ are the only person in the room]

If instead we assume Sauerland's interpretation, (34) may seem unproblematic at first, because the plural feature will not restrict the variable to non-atoms and will create no offending semantic presupposition. But the problem returns on the level of implicated presuppositions. The implicated presupposition of (34) is that, for all the speaker knows, not every atom in $g_c(2)$ is an atom, and this is also incoherent. We conclude that the LF for (33) must not have a plural feature on the bound pronoun, whether plural triggers semantic or merely implicated presuppositions. Rather, we need an LF with a featureless, or at least numberless, pronoun such as (35).[17]

(35) 3rd-pl$_2$ each 4[t$_4$ think (3rd)$_4$ are the only person in the room]

And it is not just the number feature that's semantically inert in pronouns bound by floated quantifiers. As Rullmann (2004) notes, person is affected

[15] See e.g. von Stechow (2003), Rullmann (2003).

[16] From Sauerland (2003).

[17] This is also Sauerland's own conclusion about his example, and his reason for exempting bound-variable pronouns generally from his discussion.

too.[18] Suppose that (36) is uttered by one of the losers after a presidential election, and by "we" he means himself and the other candidates.

(36) We each thought we would win.

The intended meaning is that each candidate expected himself to win. This requires a bound construal of the second *we*. If there were an active first person feature on this bound variable, as in (37), it would generate the presupposition that each candidate includes the speaker.

(37) 1st-pl$_2$ each 4[t$_4$ think 1st$_4$ would win]

And once again there is also a flip-side to the undergeneration problem. Can we correctly predict that the relevant bound readings do *not* show up with any other choice of pronoun? Can we rule out LFs like the following?

(38) They each thought that he is the only person in the room.
LF: *3rd-pl$_2$ each 4[t$_4$ think 3rd-sg-masc$_4$ is the only person in the room]

(39) We each thought she would win.
LF: *1st-pl$_2$ each 4[t$_4$ thought 3rd-sg-fem$_4$ would win]

Both of these receive perfectly reasonable semantic presuppositions on Sauerland's account. And (39) still does even if we revert to the original, stronger semantics of third person. There are no implicated presuppositions on which deviance might be blamed either. Our current theory makes doubly wrong predictions: a floated *each* (or other plural distributive quantifier) not only shouldn't be able to bind a plural pronoun, but it should be able to bind a singular pronoun.[19]

2.3 A syntactic account of uninterpreted features

2.3.1 *Feature Transmission*

A standard response to the data just surveyed is to allow syntactic derivations in which φ-features on a bound pronoun may be present on the surface but

[18] For gender, the issue does not arise in this case, since the pronouns bound by these types of quantifiers are always plural and English (or German) does not have gendered plural pronouns. I have not investigated the issue in languages which do.

[19] Safir (2004) points to this problem also: "…the optimal bound variable sentence would presumably be *They all think he is smart*, because the bound reading is semantically singular, but this does not even have a bound reading." But I disagree with Safir's implication that this problem is specifically created by the syntactic approach to uninterpreted features (a version of which I will lay out below). To the contrary, it is a puzzle that arises whenever the semantics of distributive quantification is brought together with a semantic account of the features of bound pronouns. The only solution I know of that does not appeal to a syntactic agreement mechanism is that of Rullmann (2003), but even that does not help with explaining uninterpreted *person* features as in (36).

absent at LF. Kratzer (1998), Schlenker (1999, 2002), and von Stechow (2003) offer various implementations of this idea.[20] For example, Kratzer proposes that pronouns may be base-generated with empty (or perhaps incomplete) sets of φ-features, and that they then stay this way in the course of the derivation to LF. The idea—not unnatural given our presuppositional semantics for φ-features—is that there is no real need from interpretability for the presence of φ-features. Rather, features are essentially a morphological requirement. Sometimes it may be inapplicable, for example when the pronoun is in an elided structure, and in that case the pronoun may remain featureless throughout the derivation.[21] But underlyingly underspecified pronouns also occur in structures that aren't elided, and for these to be able to meet the morphological requirement, there must be a special mechanism. Let us say this is a rule like the following.

(40) Feature Transmission under Variable Binding
In the derivation of PF, features of a DP may be copied onto variables that it binds.

(This rule presupposes a suitable definition of "binding", such as the one in Heim and Kratzer 1998: 263.) The overall effect is that only base-generated features (those present prior to transmission) will be interpreted in the semantics, and that any uninterpreted features showing up on the surface will be copies of matching features on a binder. If an underspecified pronoun is generated in an environment where Feature Transmission doesn't apply, the structure is filtered out at PF. It follows that all free pronouns must have underlying, hence semantically active, features.

There are further auxiliary assumptions required to make the Feature Transmission rule apply as intended. Specifically, we need mechanisms to generate appropriate features on the DPs that act as binders and hence as transmission licensers. To handle the cases that motivated the rule in the first place, we must assume that DPs of the form [*only* DP], [DP *each*][22] inherit the features of the DPs within them, and that DPs with certain determiners such as *all* are marked as plural. This also happens in the PF-derivation (since φ-features on DPs not of semantic type e are not interpretable and have no business being there at LF). We may or may not want to assume that a larger

[20] A related proposal is found in Pollard and Sag (1994), where features are treated as attributes of indices and hence necessarily shared under coindexing.

[21] This is an appealing analysis (in fact, the one favored by Schlenker 2002 and Safir 2004) of examples like (30).

[22] This is assuming a Sportiche-style syntax for Q-Float (Sportiche 1988). If floated quantifiers are adverbial, we need some modification to the definition of binding and/or the conventions of feature percolation.

set of complex DPs, perhaps all DPs, get specified for φ-features (in which case we have to say more about how these are generated), but for the time being, this isn't necessary.

Here are two illustrations of how underspecification of pronouns and Feature Transmission apply to the relevant examples.[23]

(41) Only I did my homework.
base-generated: [only 1st-sg$_5$] did Ø$_4$'s homework
after movement of subject, at LF: [only 1st-sg$_5$] 4[t$_4$ did Ø$_4$'s homework]
after feature percolation: *1st-sg*-[only 1st-sg$_5$] 4[t$_4$ did Ø$_4$'s homework]
after Transmission, at PF: *1st-sg*-[only 1st-sg$_5$] 4[*1st-sg*$_4$ did *1st-sg*$_4$'s homework]

(42) You each thought you'd win.[24]
base: [2nd-pl$_5$ each] thought Ø$_4$ would win
LF: 2nd-pl$_5$ 6[[t$_6$ each] 4[t$_4$ thought Ø$_4$ would win]]
Transmission: 2nd-pl$_5$ 6[[*2nd-pl*$_6$ each] 4[t$_4$ thought Ø$_4$ would win]]
percolation: 2nd-pl$_5$ 6[*2nd-pl*-[*2nd-pl*$_6$ each] 4[t$_4$ thought Ø$_4$ would win]]
Transmission again: PF:
2nd-pl$_5$ 6[*2nd-pl*-[*2nd-pl*$_6$ each] 4[*2nd-pl*$_4$ thought *2nd-pl*$_4$ would win]]

As already argued, the LFs that Feature Transmission helps us pair with the sentences here are adequate to express the observed bound readings. If derivations with underlyingly underspecified pronouns are never forced, we also generate alternative LFs in which the pronouns are bound yet do have their features interpreted. This is not a problem if the resulting interpretations are deviant in a way that filters them out. One way of ensuring this is to interpret *only* and *each* as projecting universal presuppositions about all the members of their domains.

2.3.2 *Feature Transmission and the problem of overgeneration*

The introduction of underlyingly underspecified pronouns and the Feature Transmission rule served to account for the bound readings of first- and second-person pronouns and of certain plural pronouns that our original

[23] I am assuming that Transmission also is responsible for φ-features on traces (which we don't hear directly, but have indirect evidence for from verbal agreement). We don't want to assume that features on traces arise automatically as a by-product of movement. If there was a first person feature on the trace of *only I* in the LF of (24), this would give rise to the same undesirable presupposition as an interpreted first person feature on the overt bound pronoun.

[24] This is a derivation à la Sportiche (1988): the floated quantifier is stranded by the subject that moves out of it.

theory was unable to generate. It is transparently a device to generate more LFs than we previously could, and thus to correct a problem of undergeneration. As we have noted, however, our initial theory also suffered from overgeneration. There was no obvious explanation of why we do not find bound readings in (43) or (44).

(43) Only I did her homework.

(44) They each thought he had won.

Is the new theory any better off with respect to this problem? Not right off. We still always have the option of base-generating all the features that show up at PF, so there is still nothing that prevents the problematic LFs (in which the pronouns are bound and their features all interpreted). These examples suggest, then, that we need to eliminate this option. We can do this by making Feature Transmission obligatory and unconditional. It is not, after all, driven by a mere morphological need for featural completeness; rather whenever there is binding, the binder's φ-features must all be copied onto all its bindees, regardless of whether these are underspecified. If a bindee already has its own features, the result of Transmission may then be a contradictory specification, e.g., *1st-3rd* or *sg-pl*. This, we take it, will be filtered out as unrealizable at PF. For (43) and (44), this leaves no way to generate a bound reading. More generally, a bound pronoun can never disagree in any feature with its binder. If it is not underlyingly unspecified, then at best it can have inherent features which happen to match the binder's or for which the binder is unspecified.[25]

Are there other solutions? It may be appropriate to remember at this point that the problem with (43) arises only under Sauerland's weak semantics of the third person. If third person semantically presupposed "excludes the speaker," the bound construal of (43) would have a contradictory presupposition. But this potential solution for (43) does not generalize to (44). There we had difficulty ruling out a singular bound pronoun even with our non-trivial presupposition for singular. I conclude that the overgeneration problem has to be solved in the way indicated, and I reformulate (40).

(45) Feature Transmission under Variable Binding (final version)
In the derivation of PF, all features of a DP must be copied onto all variables that it binds.

[25] Exercising this latter option allows us to maintain Cooper's account of gender: if quantificational DPs such as *every boy*, *every student* are not specified for gender, then nothing stands in the way of them binding pronouns with underlyingly specified, hence semantically interpreted, gender.

2.3.3 *Feature Transmission and split-bound pronouns*

Rullmann (2004) was the first to discuss uninterpreted features and split binding in the same context, and he concluded that it was difficult to fit the two phenomena into a coherent and principled account. Let us analyze his problem cases. I quote:[26]

Imagine John is in one room with all of his ex-wives, and he says to them:

[46] Even in the middle of the divorce proceedings, you each pretended that we were a happy couple.

[. . .] this sentence has a reading in which *we* ranges over pairs of individuals consisting of the speaker and one of his ex-wives.

A suitable LF and contextual assignment for this reading is (47).[27]

(47) [2nd-pl_1 each] 2[t_2 pretended (1st)-$(pl)_{2+3}$ were a happy couple]
$g_c(3) = s_c$ (= John); $g_c(1)$ = the ex-wives of s_c

I parenthesize the features on the split-bound pronoun to indicate that the LF expresses the intended reading with or without them. (They add only trivial presuppositions: for each ex-wife x, $x \oplus s_c$ is a plurality and includes s_c.) We don't have a problem with this example—as long as our syntax can generate at least one of the versions of this LF.

It is not so obvious, however, that it can. When Feature Transmission was merely optional, we certainly could just have base-generated both *1st* and *pl* and done nothing at PF. Now with Transmission obligatory, however, we must ask what that means for the case at hand. This brings to light a vagueness. In a case of split binding, what exactly are the variables that each binder binds, and what would it look like to copy features onto them? Before we consider this in more detail, let us broaden our data base. Rullmann follows up on (46) with another example:[28]

To add yet another twist, suppose again that John is in one room with all his ex-wives, but this time it is one of them who speaks to John, uttering:

[48] ?For your sake, we each pretended that we were a happy couple.

The intended reading here is one in which the first *we* refers to the ex-wives, but the second *we* is a variable ranging over pairs consisting of one of the ex-wives

[26] Rullmann (2004: 166).

[27] In this LF, the subject has been reconstructed into the position from which it moved to strand the floated *each*.

[28] Rullmann (2004: 166, n. 7).

plus the addressee ("each of us pretended that she and you were a happy couple").[29]

An LF for this reading should look as follows.

(49) [1st-pl_1 each] 2[t_2 pretended $(pl)_{2+3}$ were a happy couple]
$g_c(3) = h_c$ (= John); $g_c(1)$ = the ex-wives of h_c (which include s_c and others)

Consider also a similar example that involves *only* rather than floated *each*. Suppose one of the ex-wives says to John:

(50) All of us wanted to separate on peaceful terms, but only I wanted us to stay close after the divorce.

The intended reading of the second clause is "I wanted myself and you to stay close, and no other ex-wife wanted herself and you to stay close".

In all three of these examples, the split-bound pronoun surfaces as first person (*we*). But in (46), the *1st* feature cannot possibly have arisen by Transmission (since the binder is 2nd person), whereas in (48) and (50) it can *only* have arisen by Transmission (since not every pair of an ex-wife and John includes the speaker and therefore a base-generated *1st* would yield false presuppositions). How do we make sense of this in the context of an obligatory Feature Transmission rule? (46) suggests that the binder's feature (here *2nd*) ends up not on the complex indexed 2 + 3 that is the whole pronoun, but goes only to the smaller unit 2 that is part of this. If the same holds for (48) and (50), the binder's *1st* is also transmitted just to the 2-half of the index. Evidently, then, we need to say something more about what determines the surface feature of the split-bound pronoun as a whole, and why it sometimes matches the feature transmitted to one of the component-indices and sometimes not. It won't do to make this simply depend on whether the complex happens to have been generated with a base-generated feature of its own. For example, we must take care to prevent derivations like (51) and (52), which pair the same meanings we observed in (46) and (50) with different sentences that do not in fact allow these readings.

(51) LF: [2nd-pl_1 each] 2[t_2 pretended $Ø_{2+3}$ were a happy couple]
$g_c(3) = s_c$ (= John); $g_c(1)$ = the ex-wives of s_c
after Transmission:
[2nd-pl_1 each] 2[t_2 pretended *2nd-pl*$_{[2:2nd-pl]+3}$ were a happy couple]
spelled out as: "You each pretended you were a happy couple."

[29] Rullmann comments that "This example is much harder to process than [(46)], probably because the intended reading requires each occurrence of *we* to be interpreted differently." My feeling is that (50) is a bit easier, but not all speakers I have talked to like it either.

(52) LF: [only 1st-sg$_1$] 2[t$_2$ wanted 3rd-pl$_{2+3}$ to stay close]
g(3) = h$_c$ (= John); g$_c$(1) = s$_c$ (one of the ex-wives of h$_c$)
after Transmission:
[only 1st-sg$_1$] 2[t$_2$ wanted 3rd-pl$_{[2:\textit{1st-sg}]+3}$ to stay close]
spelled out as: "Only I wanted them to stay close."

Here is a proposal that gets the facts right. It begins with distinguishing two separate processes. One is Feature Transmission, which only targets individual variables and therefore, in the case of split binding, only affects an embedded subpart of the pronoun. The second is an operation that computes features for a complex pronoun on the basis of the features of its parts. Insofar as it deals with person features, we can state this operation as follows:

(53) (i) If i or j is unspecified for person, then leave i+j unspecified.
(ii) Otherwise, if i or j is 1st person, then specify i+j as 1st person.
(iii) Otherwise, if i or j is 2nd person, then specify i+j as 2nd person.
(iv) Otherwise, specify i+j as 3rd person.

Let us set aside number for the moment (as well as gender, which we have been ignoring already) and illustrate how this works just for person. Here is a derivation for *Only I wanted us to stay close*, under the reading described above.

(54) LF: [only 1st$_1$] 2[t$_2$ wanted Ø$_{[2:\emptyset]+[3:\textit{2nd}]}$ to stay close]
g$_c$(3) = h$_c$ (= John); g$_c$(1) = s$_c$ (one of the ex-wives of h$_c$)
by Transmission: ..... Ø$_{[2:\textit{1st}]+[3:\textit{2nd}]}$
by operation (53): ..... 1st$_{[2:\textit{1st}]+[3:\textit{2nd}]}$

Notice that we began this derivation with an underlying second-person specification for the second half of the split-bound pronoun. This is, of course, consistent with the intended reading (this variable refers to the addressee, and the presupposition triggered by *2nd* thus is unproblematic). But did we have to do it? Given (53), yes. Clause (53i) says that both parts of the doubly indexed pronoun must be specified for person before the whole pronoun can be specified for person. Since we continue to assume that spell-out requires specification by the end of the PF derivation, each variable will have to be specified either underlyingly or by Transmission. This particular variable is free, so a base-generated feature is its only option. And given the (semantic or implicated) presuppositions associated with each feature-value, *2nd* is the only choice consistent with the intended reading.

The reader can verify that the person features in Rullmann's examples (46) and (48) can be generated similarly (again, with appropriate underlying

person features on the unbound halves of the pronouns). We can also see how the bad form–meaning pairs in (51) and (52) are ruled out: In (51), for example, we must specify the variable 3 for person if we want *any* person to surface on the pronoun. And since it refers to the speaker, it must be first person. Then the second clause of (53) applies and makes the whole pronoun *1st*.

As for number, we have two options which both make correct predictions. We can add a clause to (53) that says to always specify i+j as plural. Or we can assume that number isn't specified by this operation at all. In that case, all pronouns with complex indices better bring to PF an underlying number specification. And this will always have to be plural, given the semantics of +. The second option is more attractive, because it gives a principled answer to the question why split-bound pronouns are plural rather than singular. In the first option, this is stipulated and not related to what plural or singular mean. The features inserted by the operation in (53) are, after all, only visible to the phonology and not interpreted.

By the same token, of course, it is very unsatisfying that we need to posit an operation like (53) in the PF-derivation at all, even one which is only responsible for person features. The various clauses in (53) do not look simple or natural from a purely formal, morphological point of view. Moreover, clauses (ii)–(iv) bear an uncanny resemblance to a set of theorems about sum-formation and inclusion:

(55) Let s_c and h_c be atoms.[30] Then:
If x or y includes s_c, x $\oplus$ y includes s_c.
If neither x nor y includes s_c, but x or y includes h_c, then x $\oplus$ y doesn't include s_c but includes h_c.
If neither x nor y includes s_c or h_c, x $\oplus$ y doesn't include either s_c or h_c.

Given the ontological facts in (55) and the semantics of the three person features, the PF operation in (53) largely duplicates predictions that we would already be making without it if all the person features on split-bound pronouns were freely base-generated and semantically interpreted. It is impossible to accept this as a mere accident. Yet we cannot simply get rid of (53) and let the semantics do all the work. In a very small subset of the cases that (53) correctly describes, a split-bound pronoun is first or second person not because of what these features mean, but because one of its bound components brings them in via Feature Transmission. In other words, it is crucial to our analysis that the operation in (53) can be fed by Feature Transmission, and since the latter is a PF rule, the former must be too. We are therefore left in the uncomfortable

[30] If s_c and h_c could be pluralities, the second and third clauses could be false.

situation that a pattern in the data which looks like it ought to fall out from the semantics, and which almost does, nevertheless has a few marginal instances that force us to attribute it to an arbitrary-looking non-semantic mechanism.

2.4 Summary and outlook

This paper has developed a mixed semantic and syntactic account of the distribution of φ-features on bound pronouns that I believe is more precise and has better empirical coverage than previous accounts of the phenomena. The main message, however, is that we cannot be satisfied with this story. The burden that we have ended up putting on the PF derivation is very likely misdescribed or misplaced. The operation we had to posit in the end for the person features in split-bound pronouns was especially impalatable. But it may well be said that this only vindicates the suspicions that some have already had about the Feature Transmission rule, a PF operation which relies on a syntactic definition of semantic binding. It would certainly be desirable if we could preserve the more natural ideas in the present package (the semantics of features, the existence of underspecified pronouns at LF) and explain away the apparent need for feature-copying operations in the syntax or morphology, unless these can be reduced to independently known syntactic and morphological mechanisms. At the time of this writing, such alternatives are only available in rough sketches or for limited subsets of the data. But far from discrediting or superseding those efforts, the present paper will hopefully help spur their pursuit.

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