FEATURAL VARIABLES*

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Abstract

A long line of research takes some sign language loci to be the overt realization of variables. Kuhn 2014 argues that this analysis fails in two cases. (i) First, loci sometimes appear to be inherited through agreement rather than directly interpreted, in particular in those environments in which *phi*-features are known to remain uninterpreted (= 'Kuhn's Generalization'). (ii) Second, there are cases in which one and the same locus can refer to different individuals, in contradiction with the predictions of the standard theory. Kuhn concludes that sign language loci are an open class of features rather than of variables; and he provides a variable-free treatment of them, although without accounting for their deictic uses. While granting the correctness of Kuhn's Generalization, we offer an alternative in which loci are both features and variables: some loci (in particular deictic ones) obtain their value from an assignment function, and introduce presuppositions on the value of other (covert) variables; but loci are also subject to the same rules of agreement as *phi*-features, and thus remain uninterpreted in other environments. Finally, we argue that spoken languages also have expressions that are featural but also contain a variable element

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It is a pleasure to dedicate this little piece to Irene Heim. Like generations of linguists, I learned from Irene the art and beauty of formal semantics. But she taught by example more general lessons as well - for instance, that one needn't always start arguing before one has thought things through, and that sometimes the voice of reason is better heard while one is pausing in silence (it *does* help if one can simultaneously contemplate Irene pausing as well and looking out the window while assessing the consequences of one's proposals). Irene also instilled in her students that winning the argument isn't the only nor even the main thing - and that really understanding the space of possible theories can be more rewarding in the long term, even if this entails spending time developing theories that one might have preferred to 'refute' rather casually. These were not inconsequential lessons.

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1 Loci as variables or loci as features?

1.1 Loci as variables

Lillo-Martin and Klima (1990) argued that logical variables or 'indices', which are usually covert in spoken languages, can be overtly realized in sign language by positions in signing space or 'loci'. In case a pronoun is used deictically or indexically, its locus usually corresponds to the actual position of its denotation, be it the speaker, the addressee, or some third person (e.g. Meier to appear). If the pronoun is used anaphorically, the antecedent typically establishes a locus, which is then 'indexed' (= pointed at) by the pronoun. In (1a) (ASL), the sign names *Bush* and *Obama* establish loci by being signed in different positions; in (1b), the antecedent DPs are accompanied with pointing signs that establish the relevant loci. In quantificational examples, indexing disambiguates among readings, as in (2) (LSF).

(1) a. IX-1 KNOW BUSH_a IX-1 KNOW OBAMA_b. IX-b SMART BUT IX-a NOT SMART.
'I know Bush and I know Obama. He [= Obama] is smart but he [= Bush] is not smart.'

b. IX-1KNOW PAST PRESIDENT IX-a IX-1 KNOW NOW PRESIDENT IX-b. IX-b SMART BUT IX-a NOT SMART.
'I know the former President and I know the current President. He [= the current President] is smart but he [=the former President] is not smart.'
(ASL; 4, 179 Schlenker 2011)

(2) DEPUTY_b SENATOR_a CL_b-CL_a IX-b a-TELL-b IX-a / IX-b WIN ELECTION
'An MP_b told a senator_a that he_a / he_b (= the deputy) would win the election.' (LSF; 4, 233)

In addition, it was argued in recent research that *if* loci are indeed the realization of indices, they can shed new light on some foundational issues in semantics, for instance on the necessity of a dynamic logic to handle anaphora (Schlenker 2011), on the existence of a uniform anaphoric system in the nominal, temporal and modal domains (Schlenker 2012), or even on the very nature of variables (Schlenker et al. 2013).

1.2 Kuhn's objections

Against this tradition, Kuhn (2014) argues that loci are features rather than variables. He gives two arguments: one pertains to the existence of uninterpreted loci under *only*; the other involves multiple occurrences of the same locus to refer to different individuals.

□ *Variable capture: uninterpreted loci under 'only'*

First, Kuhn shows that under *only* the loci-as-variables view under generates, as in (3). (Here and in what follows, ASL examples – both Kuhn's and ours – are assessed on a 7-point scale, with 7 = best.)

(3) 7 IX-a JESSICA TOLD-ME IX-b BILLY ONLY-ONE FINISH-TELL POSS-b MOTHER POSS-b FAVORITE COLOR
'Jessica told me that only Billy told his mother his favorite color.'
Can be read as: bound-bound, bound-free, free-bound, or free-free. (Kuhn 2014)

Let us focus on the (available) 'bound-free' reading, on which the boxed possessive is read as bound by *ONLY-ONE* while the underlined possessive refers to Billy.[1] For the boxed possessive *POSS-b* to be bound, *ONLY-ONE* must somehow bind this variable, say by way of a Logical Form akin to (4), with the assumption that *IX-b BILLY* comes with a requirement that *b* denotes Billy, and that there is an empty copula preceding *ONLY-ONE* to yield a meaning such as: 'Billy is the only person who…'.

(4) IX-b BILLY ONLY-ONE λb t_b FINISH-TELL POSS-b MOTHER POSS-b FAVORITE COLOR

It is immediate that if the boxed possessive is bound by λb, the underlined pronoun, which is lower in the structure, cannot get a deictic reading on which it denotes Billy. We have thus failed to derive the bound-free reading.[2]

On the view that loci may be interpreted, these data suggest that there are some environments in which they can be disregarded as well. Precisely this view is standard for *phi*-features, which are believed to be interpreted on free pronouns but to remain uninterpreted on bound variables under *only* (this similarity between loci and *phi*- features is what we call 'Kuhn's Generalization'). While there have been numerous analyses of *phi*-feature deletion (e.g. Heim 1999, 2008, Jacobon 2012, Kratzer 2009, Schlenker 1999, Stechow 2004, Sudo 2013), we will assume a simple-minded account on which a feature *F* on a pronoun *pro* can remain uninterpreted if *pro* is bound by an

[1] In fieldwork with a consultant that Kuhn also worked with, we elicited a different paradigm in which the context was strongly biased towards a bound-free interpretation, as shown in (ia) (averages on our usual 7-point scale are given over three trials). We believe that these further data confirm Kuhn's insights.

(i) JOHN J_a BILL B_a MARY M_a THE-THREE-a,b,c COP TEAM. YESTERDAY THE-THREE-a,b,c FIND IX-c PREGNANT. EVENING DISTRIBUTE HOME CONVERSATION-rep.
'John, Bill and Mary are a team of cops. Yesterday, they found out that Mary is pregnant. In the evening, they each had a conversation in their respective homes.'

a. 7 THE-THREE-a,b,c ONLY-CL-c FEEL ANXIOUS BEFORE IX-c ANNOUNCE IX-c PREGNANT.
'Of these three, only Mary felt anxious before she announced that she was pregnant.' (ASL; 22, 92b)

b. 6.3 BEFORE IX-c ANNOUNCE IX-c PREGNANT THE-THREE-a,b,c ONLY-CL-c FEEL ANXIOUS.
'Before she announced that she was pregnant, of these three, only Mary felt anxious.' (ASL; 22, 94b)

When asked what one could infer about John, our informant noted on the first trial that (ia), but not (ib), lead to the inference that John told his family that Mary was pregnant. On the other two trials, he noted that (ia) but not (ib) weakly implied that John might have told his family about Mary's pregnancy. These preliminary facts can be explained if (ia) has a reading on which *IX-c* is bound and IX-c is free, and *BEFORE* triggers a (weak) factive presupposition, which is then projected according to the rule in (19) below. In (ib), the *BEFORE*-clause clause is not in the scope of *ONLY-CL-c*, hence no bound reading is available. These data could be theoretically helpful because the *BEFORE*-clause is presumably an island for the covert movement of pronouns. If so, we can reiterate Kuhn's argument as follows: in (ia), can get a bound reading, which shows that the temporal clause is in the scope of *ONLY-CL-c*. *IX-c* is trapped in the same island, and yet has a strict reading. But it couldn't be that the very same variable *c* has a bound and a strict reading in this configuration. (Note that Kuhn's example in (3) might include an island as well if *ONLY-ONE* has a relative clause as its sister.)

[2] The same issues arise in examples with ellipsis. But these arguably involve independent problems: in ellipsis resolution, it has been argued that a Logical Form with a bound variable representation can give rise to a strict reading in the elided clause (Fox 2000, Schlenker 2005). This is the reason the present discussion solely appeals to strict readings under *only*.

element with feature *F*. A simple rule is stated in (5) and illustrated in (6), where ~~*her*~~$_i$ and ~~*my*~~$_i$ represent pronouns whose gender and person features remain uninterpreted.

(5) a. Optionally delete the feature *F* of a variable v^F if (i) v^F appears next to a λ-abstractor λv^F, and the appearance of λv^F is triggered by an expression with feature F, or (ii) v^F is bound by λv^F.[3]

b. λ-abstractors inherit the features of the expressions that trigger their appearance.

(6) In my study group,

a. only Mary did her homework (... therefore John didn't do his).

a′. only Mary λi^{fem} t_i did ~~her~~$_i$ homework

b. only I did my homework (... therefore others didn't do theirs).

b′. only I λi^{1st} $t_i^{\sout{1st}}$ did ~~my~~$_i$ homework

We add for future reference that Schlenker (1999) and Stechow (2004) posit that expressions like *now* can trigger the deletion of present tense features as well. For Schlenker (1999), this is because interpretable features are maximally used to constrain the denotation of expressions of referential type, hence the present tense feature can be added to *now*. The motivation lies in examples such as (7a), analyzed as (7b) – where i_k is a time variable, which despite its present tense features can range over past moments as well. Tense feature are deleted by virtue of agreeing with *unpronounced* features on *now*.[4]

[3] As far as we can tell, (i) is immaterial for the spoken languages that have been described, because features cannot be assigned values by λ-operators. Things will be different when we consider (18) below.

[4] For Stechow (2004), by contrast, *now* doesn't itself carry the feature (as it is of type <i, <it, t> rather than i), but associates with a time variable that carries the relevant feature.

Note that Bulgarian definite descriptions might be similar to *now in* being able to 'acquire' a feature which is not overtly spelled out, but triggers agreement phenomena. Thus in (ia), the plural description, which is unmarked for person, still triggers first person agreement on the verb. Furthermore, it is unlikely that this is due to a null pronoun co-occurring with a left-dislocated description, as left-dislocation is degraded with an overt pronoun, as shown by (ib).

(i) a. Visokite zheni imame hubavi drehi.
the-tall women have-1st-plural nice clothes
'We the women have nice clothes.'

b. ??Visokite zheni, nie imame hubavi drehi.
the-tall women we have-1st-plural nice clothes
(R. Pancheva, p.c.)

Crucially, despite the fact that definite descriptions are morphologically unmarked for person, they can trigger deletion of first person plural features under *only*, as in (iia) (where verbal first person features must be deleted) and in (iib) (where both verbal and pronominal features must be deleted). One possibility is that the subject has the representation *[the-women]*$^{1st\,plural}$, and that the subscripted feature triggers deletion of the same feature lower in the structure – just as the feature *pres* in (7b).

(ii) a. Samo zhenite imame hubavi drehi.
only the-women have-1pl nice clothes
'Only we the women have nice clothes.'

b. Samo zhenite se grizhim za nashite figuri.
only the-women refl take-care-1pl for our figures
'Only we the women take care of our appearance.' ($\Rightarrow$ bound reading) (R. Pancheva, p.c.)

(7) a. Only now is the Concord in Paris. (Therefore it wasn't there before.) (Schlenker 1999)
b. only now^{pres} λ i^{pres} i$_k$^{pres} be the Concord in Paris

Kuhn's Generalization can be further strengthened by considering the behavior of feature-like elements within sign language itself. Schlenker (to appear) argues that height specifications of loci behave like *phi*-features in that (i) they normally have a presuppositional semantics (e.g. high loci normally denote tall, important or powerful individuals), while (ii) under *only* (and ellipsis), they can remain uninterpreted. The data about *only*, illustrated in (8), suggest that Kuhn is exactly right: not just loci but other feature-like elements can be disregarded under *only*. As was the case for *now* in (7), we must posit in (8) that the subject *HEIGHT*$_a$ (signed neutrally, and meaning something like 'the tall one') is given a 'high' feature (compatible with its semantics), which in turn triggers feature deletion on the boxed object pronoun, as in (8b).

(8) Context: Tomorrow there is a swimming competition. A French team with a giant in it competes against a German team with a dwarf in it.
a. 7 COMPARE [FRENCH VERY HEIGHT MAN]$_a$ [GERMAN SHORT-PERSON]$_b$ ONLY *HEIGHT*$_a$$^{[high]}$ LIKE PEOPLE SUPPORT **IX-a^{high}**.
Preferred reading: bound variable
'Comparing the very tall French man and the short German person, only the tall man likes people who support him.' (ASL, 17, 71; Schlenker, to appear)
b. only height^{high} λ k^{high} k^{high} like people who support pro$_k$^{high}

□ *Locus re-use*

Kuhn (2014) offers a second argument against the loci-as-variables approach. In (9) a single locus is assigned to John and Mary, and another locus is assigned to Bill and Suzy. As a result, the boxed occurrences IX-a and IX-b refer to John and Mary respectively, while the underlined pronouns IX-a and IX-b refer to Mary and Suzy.

(9) 6 EVERY-DAY, JOHN$_a$ TELL MARY$_a$ IX-a LOVE IX-a. BILL$_b$ NEVER TELL SUZY$_a$ LOVE IX-b.
'Every day, John$_i$ tells Mary$_j$ that he$_i$ loves her$_j$. Bill$_k$ never tells Suzy$_l$ that he$_k$ loves her$_l$.' (ASL, Kuhn 2014)

As Kuhn observes, this example is problematic for the variable-based view. The initial association of the proper name *JOHN* with variable *a* should force *a* to refer to John; but then how can *a* also refer in the same clause, and without any intervening binder, to Mary? By contrast, these data are unproblematic for the feature-based analysis of loci: just like two DPs may bear the same feminine gender features while denoting different individuals, so it is with loci-as-features. (There might be pragmatic constraints – such as clarity – that explain why this pattern isn't more prevalent in sign languages.)

2 Loci as variables and as features

Kuhn 2014 constructs a variable-free fragment in which loci are features inherited through agreement. He accepts the consequence that features need not be part of a closed inventory, since there is no natural upper bound on the number of loci that can appear in a sentence (though there are clear performance limitations). We now sketch an alternative in which loci are both variables and features: deictic loci are interpreted as free variables; while bound loci may remain uninterpreted in some environments.

□ *The importance of deictic readings*

Kuhn (2014) does not handle deictic readings of loci. As mentioned, when individuals are present in the discourse situation, the signer normally points towards them to realize deixis. This is significant because deictic loci have no antecedent in the discourse, and thus Kuhn's system would have to be modified to capture these uses. By contrast, the loci-as-variables view can simply posit that in these cases loci are free variables whose value is given by an assignment function (provided by the context), and come with a presupposition that their realization in signing space must correspond to the actual position of their denotations.[5] Importantly, deictic loci are no different from other loci in their ability to give rise to bound readings, as shown in (10); it is thus desirable to develop an analysis that handles all loci on a par.

(10) a. 7 JOHN$_a$ MARY$_b$ IX-1 THE-THREE-a,b,1 ONLY-CL-1 FINISH WRITE POSS-1 HOMEWORK.
'Of John, Mary and I, only I finished writing my homework.' (ambiguous: the others didn't finish writing their homeworks / the others didn't finish writing my homework) (ASL; 22, 09; 2 judgments)

b. 7 JOHN$_a$ MARY$_b$ IX-2 THE-THREE-a,b,2 ONLY-CL-2 FINISH WRITE POSS-2 HOMEWORK.
'Of John, Mary and you, only you finished writing your homework.' (ambiguous: the others didn't finish writing their homeworks / the others didn't finish writing your homework) (ASL; 22, 11; 2 judgments)

□ *Phi-features*

Let us start with a standard treatment of gender, extended to person (e.g. Cooper 1979, Schlenker 2003, Heim 2008, Sauerland 2008).[6] Assuming that the semantics is relativized to a context, a world and an assignment function, we posit the interpretive rules in (11), where # encodes presupposition failure. An example is given in (12).

[5] See Schlenker et al. (2013) for a discussion of the interaction between this rule and patterns of 'locative shift'.

[6] See Wechsler (2010) for a critique. Note also that without addition the treatment of second person features in (11c) would, if applied to French, predict that the sentence *Chacun de vous pense que tu es le plus intelligent* (lit. 'Each of you-pl thinks that you-sg be-2sg the smartest') has a bound reading meaning: '[Each of you]$_i$ thinks that he$_i$ is the smartest of the two'. This is incorrect.

(11) Let c be a context of speech with speaker c_a and addressee c_h, w a world, and s be an assignment function. If E is an expression of type e, *f* is a feminine feature, *1* a first person feature, *2* a second person feature, and *i* is in index,

a. $[\![E^f]\!]^{c, s, w} = \#$ iff $[\![E]\!]^{c, s, w} = \#$ or $[\![E^f]\!]^{c, s, w}$ is not female in the world of c. If $[\![E^f]\!]^{c, s, w} \neq \#$, $[\![E^a]\!]^{c, s, w} = [\![E]\!]^{c, s, w}$

b. $[\![E^1]\!]^{c, s, w} = \#$ iff $[\![E]\!]^{c,s,w} = \#$ or $[\![E]\!]^{c, s, w}$ is not the speaker of c. If $[\![E^1]\!]^{c, s, w} \neq \#$, $[\![E^1]\!]^{c, s, w} = [\![E]\!]^{c, s, w}$

c. $[\![E^2]\!]^{c,s,w} = \#$ iff $[\![E]\!]^{c,s,w} = \#$ or $[\![E]\!]^{c, s, w}$ is not an addressee of c. If $[\![E^2]\!]^{c, s, w} \neq \#$, $[\![E2]\!]^{c, s, w} = [\![E]\!]^{c, s, w}$

d. For every $i \in \mathbb{N}$, $[\![pro_i]\!]^{c, s, w} = [\![i]\!]^{c, s, w} = s(i)$

(12) $[\![pro_i{}^f]\!] = \#$ iff s(i) $(= [\![pro_i]\!]^{c, s, w})$ is not female in the world of c. If $[\![pro_i{}^f]\!]^{c, s, w} \neq \#$, $[\![pro_i{}^f]\!]^{c, s, w} = [\![pro_i]\!]^{c, s, w} = s(i)$.

It is immediate that *phi*-features on deictic pronouns are presuppositionally interpreted. For bound pronouns, the rule in (5) entails that only a feature that cannot be inherited from the relevant binder must have an interpretive effect. A case in point is the English sentence in (13a), which arguably triggers the inference that all of the addressee's collaborators are females. This inference follows from the Logical Form in (13b), together with the standard assumptions that (i) each object that satisfies the NP- restrictor must satisfy the presuppositions of the VP-nuclear scope, and that (ii) presuppositions project out of questions.

(13) a. Is each of your four collaborators proud of herself?
⇒ each of your collaborators is female

b. [each your-collaborator] λ x t_x proud-of $pro_x{}^f$

By contrast, in cases such as (14) we must appeal to the rule in (5) to ensure that the feminine features of her remain uninterpreted.

(14) In my study group,

a. only Mary did her homework (. . . therefore John didn't do his).

b. only Mary λ i t_i did ~~her~~$_i$ homework

□ *Loci*

We will now suggest that a similar semantics can be extended to loci. But whereas the features in (11) have a semantics which is only sensitive to the *context* parameter c, the contribution of loci is sensitive to the *assignment function s* – unless they are first and second person loci, in which case they too are sensitive to c only, as in (11b-c). Two simple rules are stated in (15) and illustrated in (16).

(15) [first version] For every locus $a \neq 1, 2$, if E is an expression of type e, $[\![E^a]\!]^{c, s, w} = \#$ iff $[\![E]\!]^{c, s, w} = \#$ or $[\![E]\!]^{c,s,w} \neq s(a)$. If $[\![E^a]\!]^{c, s, w} \neq \#$, $[\![E^a]\!]^{c, s, w} = [\![E]\!]^{c, s, w}$.

(16) Assume that *a* is a non-first, non-second person locus and that $s(i) \neq \#$. Then $[\![pro_i{}^a]\!]^{c, s, w} \neq \#$ iff $[\![pro_i]\!]^{c,s,w} = s(a)$. If $[\![pro_i{}^a]\!]^{c, s, w} \neq \#$, $[\![pro_i{}^a]\!]^{c, s, w} = [\![pro_i]\!]^{c,s,w} = s(i)$.

So far we haven't said anything about loci that appear on expressions that are of quantificational type. We assume that in this case a DP associated with locus *a* introduces a λ-operator that binds variables with feature *a* (expressions of type e can but need not display this behavior). A rule is stated in (17):

(17) If a DP d^a carries a third person locus *a*, (a) or (b) or both hold:
  a. d^a is interpreted in accordance with rule (15a), or
  b. d^a introduces a λ-operator binding variables carrying the feature *a*, and interpreted in accordance with (18) (for the λ-operator) and (15a) (for the variable).

We will ask below whether we also need a rule such as (18), where a λ-operator simultaneously binds a variable *i* and the locus feature *a* that it carries.

(18) For any expression *E*, any variable *i* of type e and any locus $a \neq 1, 2$,
$[\![\lambda \mathrm{i}^{\mathrm{a}}\ \mathrm{F}]\!]^{\mathrm{c,\ s,\ w}} = \lambda \mathrm{x}.\ [\![\mathrm{F}]\!]^{\mathrm{c,\ s[i\rightarrow x,\ a\rightarrow x],\ w}}$ (with the standard convention that s[i→x, a→x] is the assignment function which is identical to s except that it assigns x to *i* and x to *a*).

Finally, we assume that in the special case in which *only* associates with an expression *E* of referential type (individual or temporal, i.e. e or i), it is interpreted in accordance with the rule in (19); it predicts in particular a presupposition failure if an alternative to the denotation of *E* yields a failure when fed to the value of the sister of *E*, e.g. *Only John continues to smoke presupposes that alternatives to John used to smoke*.[7]

(19) For any expression E of type τ = e or i,
$[\![\text{only E}]\!]^{\mathrm{c,\ s,\ w}} = \lambda \mathrm{f}_{<\tau,\ \mathrm{t}>}$. # iff (i) for some alternative e' to $[\![\mathrm{E}]\!]^{\mathrm{c,\ s,\ w}}$ given by c, f(e') = #, or (ii) $\mathrm{f}([\![\mathrm{E}]\!]^{\mathrm{c,\ s,\ w}}) = \#$; if $\neq \#$, 1 iff for some alternative e' to $[\![\mathrm{E}]\!]^{\mathrm{c,\ s,\ w}}$ given by c, f(e') = 0.

To illustrate, consider the first person example in (20a); to abstract from irrelevant details, we treat *finish-write-the-homework-of* as an atomic predicate.

(20) a. ONLY-CL-1 FINISH WRITE POSS-1 HOMEWORK
  b. only $\mathrm{pro_i}^1$ $\boxed{\lambda \mathrm{i}^{+}\ \mathrm{t_i}^{+}\ \text{finish-write-the-homework-of}\ \mathrm{pro_i}^{+}}$
  c. only $\mathrm{pro_i}^1$ $\lambda \mathrm{i}^1\ \mathrm{t_i}^1$ finish-write-the-homework-of $\mathrm{pro_i}^1$

As in (15a)(ii), we can apply the optional rule of feature deletion to the boxed expression, as in (20b), which is interpreted as in (21a) (for clarity, we include a barred version of the deleted feature, written as $\not{1}$; and we write c_a for *the speaker of c*).

(21) a. $[\![\lambda \mathrm{i}^{+}\ \mathrm{t_i}^{+}\ \text{finish-write-the-homework-of}\ \mathrm{pro_i}^{+}]\!]^{\mathrm{c,\ s[i\rightarrow x],\ w}} = \lambda \mathrm{x}.\ [\![\mathrm{t_i}^{+}\ \text{finish-write-the-homework-of}\ \mathrm{pro_i}^{+}]\!]^{\mathrm{c,\ s[i\rightarrow x],\ w}}([\![\mathrm{pro_i}^1]\!]^{\mathrm{c,\ s[i\rightarrow x],\ w}})([\![\mathrm{t_i}^1]\!]^{\mathrm{c,\ s[i\rightarrow x],\ w}}) = \lambda \mathrm{x}.$ finish-write-the-homework-of(x)(x)
  b. $[\![\lambda \mathrm{i}^1\ \mathrm{t_i}^1\ \text{finish-write-the-homework-of}\ \mathrm{pro_i}^1]\!]^{\mathrm{c,\ s,\ w}} = \lambda \mathrm{x}.\ [\![\text{finish-write-the-homework-of}]\!]^{\mathrm{c,\ s[i\rightarrow x],\ w}}([\![\mathrm{pro_i}^1]\!]^{\mathrm{c,\ s[i\rightarrow x],\ w}})([\![\mathrm{t_i}^1]\!]^{\mathrm{c,\ s[i\rightarrow x],\ w}}) = \lambda \mathrm{x}.$ finish-write-the-

[7] See Schlenker 2009 Appendix E for theoretical and empirical discussion; in a more general treatment, this rule would be stated within a focus-based semantics. Note also that the natural reading of (7) involves a slightly different lexical entry, akin to German erst rather than English only (Stechow 2004).

homework-of'$_w$(#)(#) if x ≠ c; finish-write-the-homework-of(x)(x) otherwise = λx. # if x ≠ c_a[8]; finish-write-the-homework-of(x)(x) otherwise

Without feature deletion, we would obtain for (20c) the value in (21b), which yields a failure on all arguments except the speaker. Given the lexical entry of *only* in (19), this would incorrectly block the bound reading.

Consider now the third person example in (22), which favors a bound reading but also has a strict one:

(22) JOHN$_a$ MARY$_b$ SAM$_c$ THE-THREE-a,b,c ONLY-CL-c FINISH WRITE POSS-c HOMEWORK
'Of John, Mary and Sam, only the latter finished writing his homework.' (ASL; 22, 13; 2 judgments)

On the assumption that the λ-operator inherits the features of the DP that introduces it, we can derive two readings, as shown in (23). By the rule in (17), the subject DP may but need not carry the *c* feature, which we indicate by putting it in parentheses.

(23) a. ONLY $CL_k^{(c)}$ $λi^e$ t_i FINISH WRITE **$\boxed{POSS_i^e}$** HOMEWORK
b. ONLY $CL_k^{(c)}$ $λi^e$ t_i FINISH WRITE **$\boxed{POSS_k^c}$** HOMEWORK

On the assumption that locus features inherited through agreement remain uninterpreted, we derive the bound reading, as in (23a). For the strict reading in (23b), the locus feature of the boxed pronoun does not hurt the interpretation.

□ *Variable capture*

Now consider Kuhn's example involving 'variable capture'. As mentioned, (24a) can have four readings, including one on which $\boxed{\text{POSS-b}}$ is bound but <u>POSS-b</u> is free, and one on which $\boxed{\text{POSS-b}}$ is free but <u>POSS-b</u> is bound. Presumably Kuhn must assume that, by one mechanism or another, *ONLY-ONE* can inherit the locus feature of *BILLY* The key is then to assume that variables can be bound by (λ-operators introduced by) *BILLY*$_b$ or by *ONLY-ONE*$_b$, but that in any event the feature *b* which they inherit need not be interpreted. The two mixed readings can thus be analyzed as in (24b-c).

(24) a. IX-b BILLY ONLY-ONE FINISH-TELL $\boxed{\text{POSS-b}}$ MOTHER <u>POSS-b</u> FAVORITE COLOR
b. **billy$_b$ $λi^{ƀ}$ only one$_b$ $λk^{ƀ}$ t_k tell $\boxed{pro_k^{ƀ}}$ mother $pro_i^{ƀ}$ favorite-color**
c. **billy$_b$ $λi^{ƀ}$ only one$_b$ $λk^{ƀ}$ t_k tell $\boxed{pro_i^{b}}$ mother pro_k^{b} favorite-color**

□ *Locus re-use*

Consider now Kuhn's argument based on variable re-use. In (9), locus *a* was used to refer both to John and to Mary, while locus *b* was used to refer both to Billy and to Suzy. We could posit that locus features are inherited through agreement, as in (25):

[8] As is standard, we assume that finish-write-the-homework-of'(#) = #.

(25) John_a λi^a Mary λk^a $t_i{}^a$ tell $\mathbf{t_k}^{\mathbf{a}}$ [$\mathbf{pro_i}^{\mathbf{a}}$ love $\mathbf{pro_k}^{\mathbf{a}}$]

But this won't account for the case in (26). Here *THE-TWO-a* indexes the position *a*, and it is not c-commanded by either antecedent DP.

(26) 7 EVERY-DAY, JOHN_a TELL MARY_b IX-a LOVE IX-b. BILL_a NEVER TELL SUZY_b IX-a LOVE IX-b. THE-TWO-a SMART.
'Every day John tells Mary he loves her. Bill never tells Suzy he loves her. Both John and Bill are smart.' (ASL; 22, 72b - 3 judgments)

At this point we can make two choices. (i) First, we may posit that variables can be deleted not just under standard but also under *dynamic* binding. If so, we could argue that *THE-TWO* has split dynamic antecedents and inherits the features of both antecedents and hence gets the feature *a* twice by way of agreement. (ii) Alternatively, we may revise (15) to only require that an expression with locus feature *a* denote a *part* of what *a* denotes – thus applying to locus features the format of (11c) (= requirement that the expression be *an* addressee, not *the* addressee).

(27) [second version] For every locus a ≠ 1, 2, if *E* is an expression of type e, $[\![\text{E}^a]\!]^{c,\,s,\,w}$ = # iff $[\![\text{E}]\!]^{c,\,s,\,w}$ = # or $[\![\text{E}]\!]^{c,\,s,\,w}$ **isn't a part of** s(a). If$[\![\text{E}^a]\!]^{c,\,s,\,w} \neq$ #,$[\![\text{E}^a]\!]^{c,\,s,\,w} = [\![\text{E}]\!]^{c,\,s,\,w}$.

In order to account for (26), all we need to posit is that *a* (and *m*) denotes the plurality John+Mary; and under this assumption, we don't need feature deletion, as seen in (28).

(28) John_a λi^a Mary λk^a $\mathbf{t_i}^{\mathbf{a}}$ tell $\mathbf{t_k}^{\mathbf{a}}$ [$\mathbf{pro_i}^{\mathbf{a}}$ love $\mathbf{pro_k}^{\mathbf{a}}$]. $\text{pro}_m{}^{\text{dual, a}}$ smart.

□ *Refining the analysis of deictic loci*

As mentioned, one advantage of the present analysis is that it provides a simple account of deictic loci. Still, a refinement is needed, since deictic loci must usually correspond to the actual position of the objects they denote. Schlenker et al. (2013) posit a presuppositional rule that can be adapted to the present system, as seen in (29).

(29) [third version] For every locus a ≠ 1, 2, if *E* is an expression of type e, $[\![\text{E}^a]\!]^{c,\,s,\,w}$ = # iff $[\![\text{E}]\!]^{c,\,s,\,w}$ = # or $[\![\text{E}]\!]^{c,\,s,\,w}$ isn't a mereological part of s(a) or $[\![\text{E}]\!]^{c,\,s,\,w}$ is present in the situtation of utterance in c and 1, $[\![\text{E}]\!]^{c,\,s,\,w}$ and *a* are not roughly aligned. If $[\![\text{E}^a]\!]^{c,\,s,\,w} \neq$ #, $[\![\text{E}^a]\!]^{c,\,s,\,w} = [\![\text{E}]\!]^{c,\,s,\,w}$.

We leave it open whether conditions on first and second person pronouns should be made to follow as a special case of (29).

3 Bound Iconic Loci

At this point, no example argues for the rule in (18), and thus we could have a system in which (i) deictic loci receive their value from an assignment function (which is itself provided by the context), and (ii) bound loci are features and are never interpreted, just as in Kuhn's system. But as we will now see, some loci are both bound and interpreted.

Schlenker et al. (2013) discuss high loci, which can be used to refer to important, powerful, or tall individuals. In the latter case, they simultaneously display a variable-like *and* an iconic semantics: loci are structured areas rather than points in space, and they play the role of simplified pictures of their denotations (Liddell 2003). The position (up or down) indexed by a pronoun or by an agreement verbs turns out to have interpretive consequences even under binding. Thus in (30), *LOOK-a_high* and *FILM IX-a_low* index the same locus *a*, but the first expression indicates that one looks at the relevant individual while she is up, and the second that one films her while she is down. (30b) makes the further point that this feature does not undergo deletion under *only*, since the inference about the *other* gymnasts involves their particular positions as well.

(30) GYMNAST COMPETITION MUST STAND BAR FINISH STAND HANG.
'In a gymnastics competition one must stand on a bar and then go from standing to hanging position.'

a. 6 ALL GYMNAST IX-a_neutral WANT IX-1 **LOOK-a_high** FINISH FILM **IX-a_low**.
'All the gymnasts want me to look at them while they are up before filming them while they are down.' (ASL; 23, 20c; 2 judgments)[9]

b. 7 ONLY-ONE IX-a_neutral GYMNAST WANT IX-1 **LOOK-a_high** FINISH FILM **IX-a_low**.
'Only one of the gymnasts wants me to watch her while standing before filming her while hanging.' (ASL; 23, 21c; 2 judgments)[10]

Crucially, the subject quantifier introduces a neutral version of locus *a*, and hence the high and low versions of the same locus cannot be inherited through agreement. With the binding rule in (18) and the iconic semantics in (31) (slightly simplified from Schlenker, to appear), the Logical Form in (32a) correctly derives truth conditions on which all instances of a are bound, but come with different positional restrictions.

(31) Let c be a context of speech, s an assignment function which assigns values to structured loci, and w a world (with c_a = the author of c; c_w = the world of c). We assume that c determines a projection π_c from the salient situations in c_w to the signing space of c_a. If *i* is a point locus which is part of a structured locus *I*, and if and s(I) denotes a human being, $[\![\text{IX-i}]\!]^{c,\,s,\,w}$ = # unless I is the projection of s(I) in the signing space of c_a according to π_c, and i is within I the projection of the upper part of the body of s(I)). If $[\![\text{IX-i}]\!]^{c,\,s,\,w} \neq$ #, $[\![\text{IX-i}]\!]^{c,\,s,\,w}$ = s(I).

(32) a. [all gymnast] $\lambda i^a\ t_i^a$ want [I look i^{a_high}] at-t and [film i^{a_low}] at-t+1

b. $[\![\lambda i^a\ t_i^a$ want I look i^{a_high} then film $i^{a\_low}]\!]^{c,\,s,\,w}$
= $\lambda x.\ [\![t_i^a$ want [I look i^{a_high}] at-t and [film i^{a_low}] at-t+1$]\!]^{c,\,s[i\to x,\,a\to x],\,w}$

[9] Our translation is motivated by answers to inferential questions. Thus in our second session, where our informant perceived an ambiguity, he entered in the computer: "Either: 1) They want me to watch them while they're up on the bar and then film them while they're off the bar, or 2) They want me to watch them while they're standing on the bar and then film them when they rotate and are hanging from the bar."

[10] In our second session, our informant entered in the computer: "One gymnast wants me to only watch her while standing on the bar and then film her when hanging from the bar. The other gymnasts want me to start filming while they're standing on the bar."

Without the binding rule in (18), we would have to posit that *a_high* and *a_low* are made of two parts: a pure locus *a* which remains uninterpreted, and an iconic locus *high* or *low* which provides positional information, as sketched in (33). But appropriate interpretive rules for these truncated positional loci have yet to be investigated.

(33) [all gymnast] λi^{a} $t_i{}^{a}$ want [I look $i^{<a, high>}$] at-t and [film $i^{<a, low>}$] at-t+1

4 Featural Variables in Spoken Language?

Having argued that ASL loci are featural variables, we will now suggest that comparable examples can be found within the tense system of English.[11]

Following Partee (1973) and Heim (1994), Schlenker (1999) and Stechow (2004) take the semantics of the past tense to involve overt time variables, which we write as t_i below. But instead of adopting the standard rules in (34) (Heim 1994), for the past tense they adopt the more complex conditions in (35):

(34) a. $[\![t_i{}^{pres}]\!]^{c, s, w} = \#$ iff $s(t_i) = \#$ or $s(t_i)$ is not within T, a salient interval around the time of c (=moments that count as present). If $[\![t_i{}^{pres}]\!]$c, s, w $\neq \#$, $[\![t_i{}^{pres}]\!]^{c, s, w} = s(t_i)$.

b. $[\![t_i{}^{past}]\!]^{c, s, w} = \#$ iff $s(t_i) = \#$ or s(i) doesn't precede the time of c. If $[\![t_i{}^{past}]\!]^{c, s, w} = s(t_i)$

(35) a. *past* spells out expressions of the form $t_i{}^{<t_k{}^{pres}}$ for some indices i, k $\in |$N

b. For any time-denoting expression *E*, $[\![t_i{}^{<E}]\!]^{c, s, w} = \#$ iff $s(i) = \#$ or $[\![E]\!]^{c, s, w} = \#$ or s(i) doesn't precede $[\![E]\!]^{c, s, w}$. If $[\![t_i{}^{<E}]\!]^{c, s, w} \neq \#$, $[\![t_i{}^{<E}]\!]^{c, s, w} = s(t_i)$

c. Derived rule (from (35b) and (34))
$[\![t_i{}^{<t_k{}^{pres}}]\!]^{c, s, w} = \#$ iff $s(t_k)$ is not within T_c or $s(t_i) = \#$ or $s(t_i)$ doesn't precede $s(t_k)$

The motivation for (35) over (34b) lies in part in (36a), with the highly simplified LFs in (36b) or (36c) (*t_0-1* abbreviates *one month before t_0*; see Stechow (2004) for a more thorough treatment, especially of the present tense). The key is that the denotation of a past tense variable need not be before the context of evaluation; in some cases, it is enough that its denotation be before a time denoted with a present tense variable.

(36) a. Whenever Pierre changes jobs, he gets into a fight with people who were his best friends one month before. (modified from von Stechow 2004[12])

b. $[\forall^{D} t_0$: $t_0{}^{pres}$ Pierre changes jobs] [$\exists$x: **$[t_0$-1]** λ**t$_1$** $\boxed{\mathbf{t_1{}^{past}}}$ **Pierre befriend x**][$t_0{}^{pres}$ Pierre fight x]

c. $[\forall^{D} t_0$: $t_0{}^{pres}$ Pierre changes jobs] [$\exists$x: **$[t_0$-1]** λ **t$_1$** $\boxed{\mathbf{t_1{}^{<t_0{}^{pres}}}}$ **Pierre befriend x**][$t_0{}^{pres}$ Pierre fight x]

[11] Schlenker (1999) speculates that the English present / past / pluperfect distinction is an abstract temporal counterpart of the proximate / obviative / further obviative distinction found in Algonquian; and he sketches a unified account of both. We do not know whether the remarks of this section apply to Algonquian.

[12] Stechow's own example is in (i), and his Logical Form is in (ii).

(i) Chaque fois que Pierre change d'emploi, il se querelle avec des gens qui étaient ses meilleurs amis un mois avant. (Schlenker p.c.)

(34) gives rise to the Logical Form in (36b); on the assumption that the domain restriction *D* on the universal time quantifier denotes an interval $\mathbf{D} \subseteq T_c$, the boldfaced part contributes the additional presupposition that *for every time t in D, t-1 precedes the time of c* – an incorrect result if **D** extends, say, several months after the time of utterance (so that the sentence states a broad regularity). By contrast, no problem arises with the Logical Form in (36c); briefly, we only get a presupposition that *for every time t in D, t-1 before t* – which is trivial.

For our purposes, what matters is that the element that spells out the past tense feature has a variable within it. We will now show that this featural and variable element is subject to the same rules of feature deletion as *phi*-features (and ASL loci). Consider the modified sentence in (37), with the addition in bold.

(37) a. Whenever Pierre changes jobs, he gets into a fight with people who were his best friends one month before, but **who were only useful at the time**.

b. $[\forall^{D} t_0$: t_0^{pres} Pierre changes jobs$]$ $[\exists$x: $[t_0\text{-}1]$ λ t_1 t_0^{pres} Pierre befriend x and **[only $\mathbf{t_1}$]** $\boldsymbol{\lambda t_2.}$ $\boxed{\mathbf{t_2}^{\mathbf{<t_0^{pres}}}}$ **useful x**$]$ $[t_0^{pres}$ Pierre fight x$]$

c. $[\forall^{D} t_0$: t_0^{pres} Pierre changes jobs$]$ $[\exists$x: $[t_0\text{-}1]$ λt_1 $t_1{}^{<t_0^{pres}}$ Pierre befriend x and **[only $\mathbf{t_1}^{\underline{<t_0^{pres}}}$] $\boldsymbol{\lambda t_2.}$** $\boxed{\mathbf{t_2}^{\mathbf{<t_0^{pres}}}}$ **useful x**$][t_0^{pres}$ Pierre fight x$]$

Simplifying, we take *at the time* to be a time variable that ends up being (possibly dynamically) bound by *a month before*, hence the simplified LF in (37b). But the past tense features of the boxed time variable will have an undesirable consequence, namely to require that for every time t in **D**, every moment which is an alternative to t-1 should be before t. As a result, we only get an inference that for every time t in D, the relevant people were not useful at times *preceding t*. By contrast, the desired inference is that for every time t in **D**, the people who had been useful at t-1 *failed to be useful at t and later* – which is the reason John could afford to get into a fight with them at t.

Getting the desired reading requires that the past tense features of the boxed variable be deleted. Schlenker (1999) and Stechow (2004) discuss simpler versions of the same problem, already seen in (7). The same mechanism can be extended to (37c): the adverbial *at that time* can receive the (underlined) past tense feature $\mathbf{<t_0^{pres}}$ (with *at that time* just represented as t_1). While this feature does not hurt the interpretation of *at that time*, it can trigger deletion of the feature of the boxed variable – as is desired. But crucially the feature in question, namely $\mathbf{<t_0^{pres}}$, includes a variable within it, which thus undergoes deletion as well. Hence there might be variables with a feature-like behavior in spoken languages too.

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'Each time that Pierre changes jobs, he quarrels with some people who were his best friends one month before.' (Stechow 2004)

(ii) $\exists t_1$ $[t_0^{pres} \subseteq t_1$ & $\forall t_2$ $[(t_2 \subseteq t_1$ & Pierre changes jobs at $t_2) \rightarrow$ Pierre quarrels at $\mathbf{t_2}$ with people that $\exists t_3$ were his friends at $t_3{}^{<}[t_3$ $\mathbf{<t_2}])]]$

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