Featural Variables*

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Abstract. A long line of research takes some sign language loci to be the overt realization of variables. But as argued in Kuhn (to appear), this analysis fails in ASL 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 ASL 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 they can thus remain uninterpreted in some other environments. We discuss their behavior both from the perspective of morpho-syntactic and of semantic theories of (apparent) feature agreement. Finally, we argue that in the tense domain spoken languages also have expressions that are featural while also containing a variable element.

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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, 2012). If the pronoun is used anaphorically, the antecedent typically establishes a locus, which is then 'indexed' (= pointed at) by the pronoun. In (1)a (American Sign Language, henceforth ASL), the sign names *Bush* and *Obama* establish loci by being signed in different positions; in (1)b, the antecedent DPs are accompanied with pointing signs that establish the relevant loci. In quantificational examples, indexing disambiguates among readings, as in (2) (French Sign Language, henceforth LSF).[1]

(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-1 KNOW 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 (to appear) argues that loci are features rather than variables. He gives two arguments: first, there are uninterpreted loci under *only*; second, multiple occurrences of the same locus may refer to different individuals.

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[1] Old data are cited from earlier publications when relevant. New data were elicited using the 'playback method' (see e.g. Schlenker et al. 2013 and Schlenker 2014): repeated quantitative acceptability judgments and repeated inferential judgments were obtained from our consultant on separate days, on videos involving minimal paradigms.
Glossing conventions are standard for sign language research, with *IX-a* encoding a pointing sign towards locus *a*, and with the subscript *a* on $BUSH_a$ (as in (1)a) indicating that the expression *BUSH* was signed in locus *a*. *CL* stands for 'classifier', and in example (2), CL_b-CL_a refers to two index finger classifiers signed simultaneously, one with the right hand and the other with the left hand. Numbers following the examples (e.g. *4, 179* in (1)) are the references of the corresponding videos.

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

Kuhn shows that under *only* the loci-as-variables view undergenerates, as in (3). (Both Kuhn's and our ASL examples are assessed on a 7-point scale, with 7 = best; numerical averages appear in lieu of the standard *, ?, ??,* etc., right before the examples.)

(3) 7 IX-a JESSICA TOLD-ME IX-b BILLY ONLY-ONE[3] 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, to appear, based on the judgments of two consultants)

Let us unpack this example. *JESSICA* is associated with locus *a* by way of the initial pointing sign *IX-a*. Then *BILLY* is associated with locus *b* by way of the pointing sign *IX-b*. Finally, the possessive pronouns *POSS-b* and *POSS-b* both index that same locus *b*. Now 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.[4] 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...'. (Unless otherwise noted, our Logical Forms are based on the kind of syntax/semantics interface discussed in Heim and Kratzer 1998, among others.)

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

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[3] We keep Kuhn's transcription, but his *ONLY-ONE* corresponds to what we would transcribe here as *ONLY-CL_one*. We treat the latter expression as pronominal when it is signed in a locus that was established earlier, and thus had a prior reference.

[4] 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 (i)a. We believe that these further data confirm Kuhn's insights.
(i) JOHN J_a BILL B_b MARY M_c 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_one-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; 3 trials)
b. 6.3 BEFORE IX-c ANNOUNCE IX-c PREGNANT THE-THREE-a,b,c ONLY-CL_one-c FEEL ANXIOUS.
Before she announced that she was pregnant, of these three, only Mary felt anxious.' (ASL; 22, 94b; 3 trials)
When asked what one could infer about John, our informant noted on the first trial that (i)a, but not (i)b, lead to the inference that John told his family that Mary was pregnant. On the other two trials, he noted that (i)a but not (i)b weakly implied that John might have told his family about Mary's pregnancy. These preliminary facts can be explained if (i)a 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 (22) below. In (i)b, the *BEFORE*-clause clause is not in the scope of *ONLY-CL_one-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 (i)a, *IX-c* can get a bound reading, which shows that the temporal clause is in the scope of *ONLY-CL_one-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.)

But if the boxed possessive *POSS-b* is bound by λb, the underlined pronoun *POSS-b*, which is lower in the structure, shouldn't be able to get a deictic reading on which it denotes Billy (nor could it denote further salient individuals – a possibility which is not tested in Kuhn's paper).[5]

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'. There are two general directions to analyze the behavior of *phi*-feature under *only*.

(i) According to *semantic analyses*, a feature *F* on a pronoun *pro* remains uninterpreted *due to its semantics* in the focus dimension (Heim 2005, Spathas 2007, Jacobson 2012). An implementation for feminine features is sketched in (5). For ease of comparison with the rest of our discussion, we adopt a framework compatible with a variable-full treatment, as in Rooth 1996; # is used to encode presupposition failure.

(5) Let *E* be an expression of type e and *f* a feminine feature, *F* a focus marker, and $[[\bullet]]^{O,c,s,w}$ and $[[\bullet]]^{F,c,s,w}$ the ordinary and focus values of • under a context c, an assignment function s and a world w.
a. $[[E^f]]^{O,c,s,w} = \#$ iff $[[E]]^{O,c,s,w} = \#$ or $[[E]]^{O,c,s,w}$ is not female in the world of c. If $[[E^f]]^{O,c,s,w} \neq \#$, $[[E^f]]^{O,c,s,w} = [[E]]^{O,c,s,w}$.
b. $[[E^f]]^{F,c,s,w} = \{[[E]]^{O,c,s,w}\}$ (i.e. the feature *f* plays no role in the focus dimension)
c. $[[E^f_F]]^{F,c,s,w} = [[E_F]]^{F,c,s,w} = E$, the set of individuals.

To illustrate, we assume that the ordinary value in (6)a is computed as usual, hence a feminine presupposition; while the focus value in (6)b ignores the features on *her*:

(6) a. $[[\text{Mary}_F\ \lambda i\ t_i \text{ did her}_i \text{ homework}]]^{O,c,s,w}$ = [λx. # unless x had a homework to do and x is female; if ≠ #, 1 iff x did x's homework](mary')
b. $[[\text{Mary}_F\ \lambda i\ t_i \text{ did her}_i \text{ homework}]]^{F,c,s,w}$ = {λx. # unless x had a homework to do; if ≠ #, 1 iff x did x's homework}(D) = {[λx. # unless x had a homework to do; if ≠ #, 1 iff x did x's homework](d): d ∈ D}

What is notable is that the feminine features have no semantic contribution in the focus dimension specified in (6)b. Thus if *only* works on top of (6)a,b, the feminine feature *f* will play no role in the focus dimension, as is desired.

(ii) According to *morpho-syntactic analyses*, a feature *F* on a pronoun *pro* can remain uninterpreted if *pro* is bound by an element with feature *F* – henceforth 'deletion under agreement' (see Heim 1991, 2008, Kratzer 2009, Schlenker 1999, 2003, Stechow 2004). A simple-minded rule is displayed in (7)-(8), where the gender/person features ~~*her*~~$_i$ and ~~*my*~~$_i$ remain uninterpreted.[6]

(7) 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

[5] 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*.

[6] See Merchant 2014 for a recent discussion of the behavior of gender (and plural) features in ellipsis contexts in Modern Greek.

appearance of λv^F is triggered by an expression with feature F, or (ii) v^F is bound by λv^F.[7]

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

(8) 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^{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 (this point will matter in the analysis of (10) below); while their analysis is morpho-syntactic, it could be re-cast within a semantic framework as well. Their argument is based on examples such as (9):

(9) a. Only now is the Concord in Paris. (Therefore it wasn't there before.) (Schlenker 1999)
b. only now$^{\text{pres}}$ λi^{pres} i_k^{pres} be the Concord in Paris

The reasoning in Schlenker 1999 is as follows. Interpretable features are maximally used to constrain the denotation of expressions of referential type, hence the present tense feature is added to *now*, as is represented in (9)b. Importantly, in this Logical Form i_k is a time variable and it carries present tense features, but despite this it can range over past moments as well: it excludes the possibility that at earlier times the Concord *was* in Paris. The proposal is that tense features are deleted by agreeing with *unpronounced* features on *now*.[8]

Kuhn's Generalization may be further strengthened by considering the behavior of feature-like elements within sign language itself. Schlenker 2014 argues that height specifications of loci behave like *phi*-features in that (i) they normally have a

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[7] 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 (20) below.

[8] 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 (this is also the behavior we attribute to the ASL expression for *the tall man* in (10) below). Thus in (i)a, 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 (i)b.

(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 (ii)a (where verbal first person features must be deleted) and in (ii)b (where both verbal and pronominal features must be deleted). One possibility is that the subject has the representation *[the-women]$^{\text{1st plural}}$*, and that the subscripted feature triggers deletion of the same feature lower in the structure – just as the feature *pres* in (9)b.

(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.' (=> bound reading) (R. Pancheva, p.c.)

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 (10), 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 (9), we must posit in (10) 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 (10)b; as a result, we obtain a ready which excludes the possibility that the short German person likes people who support *him* (despite the fact that he is short and thus that the high features specifications shouldn't be appropriate to refer to him).[9]

(10) *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**$^{\textbf{high}}$.
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 2014)
b. only height^{high} λk^{high} k^{high} like people who support pro$_k$^{high}

❑ *Locus re-use*

Kuhn (to appear) offers a second argument against the loci-as-variables approach. In (11) a single locus is assigned to John and Mary, and another locus is assigned to Bill and Suzy. As a result, the boxed pronouns IX-a and IX-b refer to John and Bill respectively, while the underlined pronouns IX-a and IX-b refer to Mary and Suzy.

(11) 6 EVERY-DAY, JOHN$_a$ TELL MARY$_a$ IX-a LOVE IX-a. BILL$_b$ NEVER TELL SUZY$_b$ IX-b 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, to appear)

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.)

❑ *Kuhn's theory*

Kuhn (to appear) solves these problems by treating loci as features which are not interpreted (so that neither the problem of variable capture nor of variable re-use can arise in the first place), but are inherited by a mechanisms of morpho-syntactic

[9] An alternative research direction likens height specifications of loci to co-speech gestures rather than to features. Importantly, some co-speech gestures were argued to display precisely the behavior under discussion here in the scope of *only,* which suggests an alternative analysis of these data (Schlenker, to appear).

agreement; this allows him to provide a variable-free treatment of loci. 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). On the other hand, he does not provide an account of deictic loci; we come back to their treatment below.

Besides positing that features are not part of a closed inventory, Kuhn's analysis must also accept a puzzling consequence: setting aside deictic and indexical loci, if in a given sentence a noun phrase N is associated with locus L and a noun phrase N' is associated with locus L', it is also the case that, in another sentence, N can be associated with L' and N' can be associated with L. The reason is that outside of the deictic/indexical realm, locus assignment is not determined by intrinsic properties of noun phrases, but by other considerations – including the order in which they appear in the sentence (for instance, our ASL consultant usually introduces loci from right to left). We do not know of cases in spoken language in which feature choice is arbitrary in this way; on the other hand, this arbitrariness is expected on the loci-as-features view.

2 Loci as variables *and* as features

We now suggest that loci are *both* variables and features: deictic loci are interpreted as free variables; while bound loci may remain uninterpreted in some environments.

- *Deictic readings*

As mentioned, when individuals are present in the discourse situation, the signer normally points towards them to realize deixis. Kuhn's system could be extended to capture these uses, by analogy with the treatment of gender and person features given in Jacobson 1999, 2012. Jacobson's proposal is that *she* and *you* behave as other pronouns in denoting an identity function, but that they come with a domain restriction to female individuals for *she* and to addressees for *you*. On this view, then, the pronoun *you* evaluated in a context c denotes the partial identity function λx_e*: x is an addressee of c* . *x*. In words, this is the function which is defined on an individual x just in case x is an addressee of c, and which outputs x itself if this condition is met. Given the rest of Jacobson's system, the sentence *You left* ends up denoting a partial function of type <e, t>, restricted to a domain of addressees[10]; and a truth value is finally obtained when that function is applied to an addressee. The same analysis could be extended to a deictic locus *a* corresponding to the position of an individual s(a): the meaning of *a* could be seen as an identity function restricted to individual s(a). Importantly, however, this

[10] The result is obtained by applying Jacobson's z-rule to the meaning of *left*. Its base meaning is of type <e, t>, and is turned into a meaning of type <<e, e>, t> after application of the z rule. The latter meaning is appropriate to compose with the meaning of *you*, which is a (partial) identity function over individuals, and hence of type <e, e>.

takes Kuhn's and Jacobson's 'features' one step closer to variables: not only is there a potentially infinite number of them (as there is no natural upper bound on the number of loci), but in an addition all the deictic ones must be associated with potentially distinct individuals – a relation that comes close to the reference relation established by assignment functions. (As was noted above, non-deictic Kuhnian features also resemble variables in being arbitrarily assigned to noun phrases irrespective of their intrinsic properties.)

Without refuting the variable-free analysis, we can offer an alternative within a variable-full system. Specifically, the loci-as-variables view can simply posit that deictic 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 spatially correspond to the actual position of their denotations. Importantly, deictic loci are no different from other loci in their ability to give rise to bound readings, as shown in (12); it is thus desirable to develop an analysis that handles all loci on a par.[11]

(12) a. 7 $JOHN_a$ $MARY_b$ IX-1 THE-THREE-a,b,1 ONLY-CL_one-1 FINISH WRITE POSS-1 HOMEWORK.
'Of John, Mary and I, only I finished writing my homework.' (the others didn't finish writing their homeworks [or: the others didn't finish writing my homework]) (ASL; 22, 09; 3 judgments)
b. 7 $JOHN_a$ $MARY_b$ IX-2 THE-THREE-a,b,2 ONLY-CL_one-2 FINISH WRITE POSS-2 HOMEWORK.
'Of John, Mary and you, only you finished writing your homework.' (the others didn't finish writing their homeworks [or: the others didn't finish writing your homework]) (ASL; 22, 11; 3 judgments)
c. *Context:* a student is present in the context. The signer is talking about that student [pointing towards him].
7 $JOHN_a$ $MARY_b$ IX-c THE-THREE-a,b,2 ONLY-CL_one-c FINISH WRITE POSS-c HOMEWORK.
'Of John, Mary and s/he, only s/he finished writing his/her homework.' (the others didn't finish writing their homeworks) (ASL, 28, 35; 1 judgment)

- *Phi-features*

To develop our theory, let us start with a standard treatment of gender, extended to person (e.g. Cooper 1983, Schlenker 2003a,b, Heim 2008, Sauerland 2008)[12]. Assuming that the semantics is relativized to a context, a world and an assignment function, we posit the interpretive rules in (13), where as before # encodes presupposition failure. An example is given in (14).

(13) 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 $[[E]]^{c,s,w}$ is not female in the world of c. If $[[E^f]]^{c,s,w} \neq \#$, $[[E^f]]^{c,s,w} = [[E]]^{c,s,w}$
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 $[[E^2]]^{c,s,w} \neq \#$, $[[E^2]]^{c,s,w} = [[E]]^{c,s,w}$

[11] See Schlenker et al. 2013 for a discussion of the interaction between this rule and patterns of 'locative shift'. Note that the distinction between first and non-first person is usually thought to be grammaticalized in ASL, but that the distinction between second and third person isn't (Meier 1990). If so, second and third person all fall under the rule for deictic loci.

[12] See Wechsler 2010 for a critique. Note also that the treatment of second person features in (13)c 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, akin to *[Each of you]$_i$ thinks that you$_i$ are the smartest of the two*. This is incorrect – *tu* definitely cannot be bound in this case.

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

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

Let us unpack these definitions. In essence, (13)a posits that an expression E^f with feminine features gives rise to a presupposition failure when evaluated under a context c, an assignment function s and a world w unless *E* denotes a female individual in the world of the context c. When no presupposition failure is obtained, E^f denotes whatever *E* denotes. (13)b and (13)c are analogous except that the presuppositional requirement is that *E* should denote the speaker or an addressee of the context c. (13)d is a standard interpretive rule for a pronoun pro_i with index *i*, and it specifies that its denotation under an assignment function s is just s(i). (14) applies (13)a and (13)d to the case of a simple feminine pronouns, with $E^f = pro_i^f$.

It is immediate that *phi*-features on deictic pronouns are presuppositionally interpreted. For bound pronouns, the rules in (5) and (7) entail (for different reasons) that in (15)a the feminine feature of *herself* might be interpreted: for the morpho-syntactic analysis, this is so to the extent that the feature cannot be deleted under agreement;[13] for the semantic analysis, this is because the focus value plays no role in (15)a. On either analysis, the desired inference follows from the Logical Form in (15)b, 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.

(15) a. Is each of your four collaborators proud of herself?
=> each of your collaborators is female
b. [each your-collaborator] λx t_x proud-of pro_x^f

By contrast, for (16), the morpho-syntactic analysis must appeal to the rule in (7) to ensure that the feminine feature of *her* remains uninterpreted; while the semantic analysis appears to (5)b to guarantee that features are ignored in the focus dimension.

(16) In my study group,
a. only Mary did her homework (... therefore John didn't do his).
b. only Mary λi 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 (13) 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

[13] The situation is complex. In (i), we need to allow *my collaborator* to carry a feminine feature in order to license a bound variable reading on which *herself* ranges over males.
(i) Only my collaborator is proud of herself.
The rule that handles (9) and (10) can also achieve the desired result in this case. But then in (15) *your four collaborators* might also carry feminine features, which could conceivably be transmitted to the quantifier *each of your four collaborators*; if so, the features of *herself* would not have to be interpreted. Interestingly, the situation will be different in our sentence with bound iconic loci in (33), where one and the same quantifier binds two variables with contradictory iconic features, and hence couldn't *transmit* them to both.

second person loci, in which case they too are sensitive to c only, as in (13)b-c. A simple rule is stated in (17) and illustrated in (18). (17)a is parallel to the rules in (13)a-c: a presupposition failure is obtained for E^a unless its denotation is that of locus *a*, and when no failure is obtained it denotes what *E* denotes.

(17) [first version] For every locus a ≠ 1, 2,
a. 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 $[[E^a]]^{c, s, w} \neq \#$, $[[E^a]]^{c, s, w} = [[E]]^{c, s, w}$;
b. if *E* is an expression of quantificational type, *a* is not interpreted and thus
$[[E^a]]^{c, s, w} = [[E]]^{c, s, w}$

(18) Assume that *a* is a non-first, non-second person locus and that s(i) ≠ #. 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 of quantificational type. Here the rules are somewhat more involved. 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). Rules are stated in (19)-(20) and schematically illustrated in (21). (We will ask in Section 3 whether in the end we need all the provisions made in (20), where the λ-operator simultaneously binds a variable *i and* the locus feature *a* that it carries.)

(19) If a DP d^a carries a third person locus *a*, (a) or (b) or both hold:
a. d^a is of type e and is interpreted in accordance with rule (17)a, or
b. d^a is immediately followed by a λ-operator binding variables carrying the feature *a*, and interpreted in accordance with (20) (for the λ-operator) and (17)a (for the variable).

(20) For any expression *E*, any variable *i* of type e and any locus *a* ≠ 1, 2,
$[[\lambda i^a\ F]]^{c, s, w} = \lambda x.\ [[F]]^{c, s[i\_x, a\_x], w}$ (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*)

(21) a. $JOHN^a$ *VP* is interpreted with (19)a and (17)a, and hence introduces a requirement that the locus *a* should denote John, i.e. s(a) = [[JOHN]] (this could have consequences if a later pronoun *IX-a* indexes locus *a*: that pronoun could refer to John as well).
b. $ONE^a\ \lambda i^a\ i^a$ *VP* is interpreted with rules (19)b, (20) and (17)a-b. *ONE* is of quantificational type and thus by (17)b its interpretation is unaffected by *a*. Taking $F = i^a$ *VP* in (20), the predicate will have the value: $[[\lambda i^a\ i^a\ VP]]^{c, s, w}$
$= \lambda x.\ [[i^a\ VP]]^{c, s[i\_x, a\_x], w}$ (by (20))
$= \lambda x.\ [[VP]]^{c, s[i\_x, a\_x], w}([[i^a]]^{c, s[i\_x, a\_x], w})$ (Function Application)
$= \lambda x.\ [[VP]]^{c, s[i\_x, a\_x], w}(x)$ (by (17)a).
The last step follow because the presuppositional constraints on *i* imposed by *a* in the expression i^a (interpreted with (17)a) will be automatically satisfied under an assignment functiont that assigns the same object x to *i* and 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 (22); 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*. For instance, the sentence *Only John continues to smoke* presupposes that individuals that are alternatives to John used to smoke.[14]

(22) For any expression E of type τ = e or i,

[14] 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 (9) involves a slightly different lexical entry, akin to German *erst* rather than English *only* (Stechow 2004).

[[only E]]$^{c, s, w}$ = $\lambda f_{<e,t>}$. # iff (i) for some alternative e' to [[E]]$^{c, s, w}$ given by c, f(e') = #, or (ii) f([[E]]$^{c, s, w}$) = #; if ≠ #, 1 iff for every alternative e' to [[E]]$^{c, s, w}$ given by c, f(e') = 0.

To illustrate, consider the first person example in (23)a; to abstract away from irrelevant details, we treat *finish-write-the-homework-of* as an atomic predicate.

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

As in (17)a(ii), we can apply the optional rule of feature deletion to the boxed expression, as in (23)b, which is interpreted as in (24)a (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*).

(24) a. $[[\lambda i^{\pm}\ t_i^{\pm}\ \text{finish-write-the-homework-of}\ pro_i^{\pm}]]^{c, s, w} = \lambda x.\ [[t_i^{\pm}\ \text{finish-write-the-homework-of}\ pro_i^{\pm}]]^{c, s[i\_x], w} = \lambda x.\ [[\text{finish-write-the-homework-of}]]^{c, s[i\_x], w}([[pro_i^{\pm}]]^{c, s[i\_x], w})([[t_i^{\pm}]]^{c, s[i\_x], w}) = \lambda x.$ finish-write-the-homework-of(x)(x)
b. $[[\lambda i^1\ t_i^1\ \text{finish-write-the-homework-of}\ pro_i^1]]^{c, s, w} = \lambda x.\ [[\text{finish-write-the-homework-of}]]^{c, s[i\_x], w}([[pro_i^1]]^{c, s[i\_x], w})([[t_i^1]]^{c, s[i\_x], w}) = \lambda x.$ finish-write-the-homework-of'$_w$(#)(#) if x ≠ c_a; finish-write-the-homework-of(x)(x) otherwise = $\lambda x.$ # if x ≠ c_a[15]; finish-write-the-homework-of(x)(x) otherwise

Without feature deletion, we would obtain for (23)c the value in (24)b, which yields a failure on all arguments except the speaker. Given the lexical entry of *only* in (22), this would incorrectly block the bound reading.

Consider now the third person example in (25), which favors a bound reading but also has a strict one:

(25) 7 $JOHN_a$ $MARY_b$ SAM_c THE-THREE-a,b,c ONLY-CL_one-c FINISH WRITE POSS-c HOMEWORK
'Of John, Mary and Sam, only Sam finished writing his homework.' (ASL; 22, 13c; 3 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 (26). By the rule in (19), the subject DP may but need not carry the *c* feature, which we indicate by putting it in parentheses.

(26) a. ONLY $CL\_one_k^{(c)}$ $\lambda i^e\ t_i^e$ FINISH WRITE $\boxed{\textbf{POSS}_i^e}$ HOMEWORK
b. ONLY $CL\_one_k^{(c)}$ $\lambda i^e\ t_i^e$ FINISH WRITE $\boxed{\textbf{POSS}_k^c}$ HOMEWORK

Assuming that locus features can be deleted under agreement, we derive the bound reading, as in (26)a. For the strict reading in (26)b, the locus feature of the boxed pronoun does not hurt the interpretation.

❑ *Variable capture*

Now consider Kuhn's example involving 'variable capture'. As mentioned, (27)a can have four readings, including one on which $\boxed{\textit{POSS-b}}$ is bound but $\underline{\textit{POSS-b}}$ is free, and one on which $\boxed{\textit{POSS-b}}$ is free but $\underline{\textit{POSS-b}}$ 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 $ONLY\text{-}ONE_b$, 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 (27)b-c. The key

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

to obtain the desired reading is that the locus *b* that appears on the embedded pronouns is inherited through agreement and thus can be ignored by the interpretive component.

(27) a. IX-b BILLY ONLY-ONE FINISH-TELL POSS-b MOTHER POSS-b FAVORITE COLOR
b. $billy_b$ λi^b $only\ one_b$ **λk^b t_k^b tell pro_k^b mother pro_i^b favorite-color**
c. $billy_b$ λi^b $only\ one_b$ **λk^b t_k^b tell pro_i^b mother pro_k^b favorite-color**

❑ *Locus re-use*

Consider now Kuhn's argument based on variable re-use. In (11), 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 (28):

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

But this won't account for the case in (29). Here *THE-TWO-a* indexes the position *a*, and it is not c-commanded by either antecedent DP.

(29) 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 under agreement not just in case of standard binding, but also in case of *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 (17) to only require that an expression with locus feature *a* denote a *part* of what *a* denotes. This would make this rule particularly parallel to that in (13)c, where we required that an expression with second person feature denote *an* addressee, and not necessarily *the* addressee.

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

In order to account for (29), 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 (31).

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

❑ *Refining the analysis of deictic loci*

As mentioned, the present analysis provides a simple account of deictic loci. Still, a refinement is needed, since deictic loci must usually correspond in signing space 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 (32); in a nutshell, it posits that the position of deictic loci must roughly correspond to that of their denotations.

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

We leave it open whether conditions on first and second person pronouns should be

made to follow as a special case of (32).

- *Intermediate summary*

Let us step back. While granting the correctness of 'Kuhn's Generalization', we have proposed that loci may simultaneously display the behavior of variable and of features. The analysis makes loci particularly similar to person features, especially second person features. These are typically assumed to have a semantics; for instance, *you* is constrained to denote an addressee of the speech act. Still, in other cases second person remains uninterpreted, as in *Only you did your homework* on its bound reading. We took loci to be similar, with the difference that they are *assignment-sensitive* rather than *context*-sensitive. By extending to loci assumptions that are standard about person, we were able to solve Kuhn's problem of 'variable capture'. We then sketched two possible solutions to the problem of 'variable re-use'. One posits that loci may remain not just under standard but also under dynamic binding. The other posits (by analogy with the interpretive rule for second person) that a locus *a* on an expression E^a only comes with a requirement that *E* denote *a part* of what *a* denotes, not that *E* denote *the same thing* as *a*.

In Section 3, we turn to cases in which bound loci are arguably interpreted. In the Appendix, we discuss recent results that crucially hinge on a treatment of plural loci as variables, with interpretive properties that iconically mirror their realization – a result which is non-trivial to match in a feature-based analysis of loci.

3 Bound Iconic Loci

At this point, no example argues for the rule in (20), 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 (33), *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. (33)b 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.

(33) 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. 6.3 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; 3 judgments)[16]
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; 3 judgments)[17]

Crucially, the subject quantifier introduces a neutral version of locus *a*, and hence the high and low versions of the same locus cannot be disregarded under agreement.

With the binding rule in (20) and the iconic semantics in (34) (slightly simplified from Schlenker 2014), the Logical Form in (35)a correctly derives truth conditions of (33)a on which all instances of *a* are bound, but come with different positional restrictions: as desired, the occurrence that comes with *LOOK-a_high* is associated with a 'high' positional restriction, while the occurrence that comes with *LOOK-a_low* is associated with a 'low' positional restriction.

(34) 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).

(35) a. [all gymnast] λi^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 $]]^{c, s[i\_x, a\_x], w}$

Without the binding rule in (20), 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 (36). But appropriate interpretive rules for these truncated positional loci have yet to be investigated.

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

It should be noted that the semantic analysis of features under *only* fails to capture (33)b, as it predicts that *high* and *low* features are obligatorily disregarded in the focus dimension. But a small modification might work: we could posit in (5)b that features are *optionally* disregarded in the focus dimension.[18]

It should also be noted that Kuhn's system *as it stands* cannot account for

[16] 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."

[17] 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."

[18] This liberalized version of the semantic analysis and the morpho-syntactic analysis of features under *only* still make different predictions. The morpho-syntactic analysis predicts that it is solely under binding that features may be disregarded in the focus dimension. The liberalized semantic analysis predicts that binding is irrelevant. (Some of our more recent examples, pertaining to 'locative shift', might argue for the latter position.)

examples such as (33), where the bound pronouns cannot inherit their features from their antecedent. Still, Kuhn might develop a version of the analysis in (36), where loci themselves are not interpreted, but the iconic restrictions they realize are; the ramifications of this move would need to be worked out, however.

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.[19]

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 (37) (Heim 1994), for the past tense they adopt the more complex conditions in (38):

(37) a. $[[t_i^{pres}]]^{c, s, w} = \#$ iff $s(t_i) = \#$ or $s(t_i)$ is not within T_c, 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 $s(i) = \#$ or $s(i)$ doesn't precede the time of c. If $[[t_i^{past}]]^{c, s, w} \neq \#$, $[[t_i^{past}]]^{c, s, w} = s(t_i)$

(38) a. *past* spells out expressions of the form $t_i^{<t_k^{pres}}$ for some indices $i, k \in \mathbb{N}$
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 (38)b and (37))
$[[t_i^{<t_k^{pres}}]]^{c, s, w} = \#$ iff $s(t_k) = \#$ or $s(t_k)$ is not within T_c or $s(t_i) = \#$ or $s(t_i)$ doesn't precede $s(t_k)$

In words: the standard rules in (37)a,b posit that a time variable with present or past tense features is constrained to denote moments that count as present or past relative to the context of the speech act. (38) posits a more complex analysis for a time variable with past tense features; very roughly, its value is constrained to precede the value of some other time variable that carries present tense features.

The motivation for (38) over (37)b lies in part in (39)a, with the highly simplified LFs in (39)b or (39)c (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.

(39) a. Whenever John changes jobs, he gets into a fight with people who were his best friends one month before. (modified from von Stechow 2004[20])

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[19] 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.

[20] 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.)
'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 $t_3{}^{<}[t_3 < \mathbf{t_2}])]]$

b. [$\forall^{D}t_0$: t_0^{pres} Pierre changes jobs] [$\exists$x: **[t_0-1] λt_1 $\boxed{t_1^{past}}$ 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] λt_1 $\boxed{t_1^{<t_0^{pres}}}$ Pierre befriend x**][t_0^{pres} Pierre fight x]

(37) gives rise to the Logical Form in (39)b; 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 (39)c; 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 can be semantically ignored under *only*, just like *phi*-features (and ASL loci). Consider the modified sentence in (40), with the addition in bold.

(40) a. Whenever John 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_0-1] λt_1 $t_1{}^{<t_0^{pres}}$ Pierre befriend x and **[only t_1 λt_2. $\boxed{t_2^{<t_0^{pres}}}$ useful x**][t_0^{pres} Pierre fight x]
c. [$\forall^{D}t_0$: t_0^{pres} Pierre changes jobs] [$\exists$x: [t_0-1] λt_1 $t_1{}^{<t_0^{pres}}$ Pierre befriend x and **[only $t_1^{<t_0^{pres}}$ λt_2. $\boxed{t_2^{<t_0^{pres}}}$ 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 (40)b. 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 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 semantic ignored. Within their morpho-syntactic analyses, Schlenker 1999 and Stechow 2004 discuss simpler versions of the same problem, already seen in (9). The same mechanism can be extended to (40)c: the adverbial *at that time* can receive the (underlined) past tense feature $^{<t_0^{pres}}$ (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 (these ideas could in principle be adapated to the semantic analyses sketched in (5)). But crucially the feature in question, namely $^{<t_0^{pres}}$, includes a variable within it, which thus undergoes deletion as well.

If this analysis is on the right track, the past tense provides another example of variables that can be ignored in the environments in which *phi*-features are.

Specifically, the past tense of *were* in (40)a was analyzed as the boxed variable $\boxed{t_2^{<t_0^{pres}}}$ in (40), and we saw that the entire past tense specification $^{<t_0^{pre}}$, including the variable t_0, can be semantically ignored.

5 Conclusion

While the present system should certainly be constrained further,[21] it preserves the main insights of the loci-as-variables approach while granting the correctness of Kuhn's key intuition, namely that loci can *also* behave like features; synthesizing the two views, it proposes that loci are often *featural variables*. Our approach deals the problems of 'variable capture' and 'variable re-use', and it also accounts for some cases in which iconic loci are bound and yield interpretive effects. While it makes use of multiple covert variables, it was never part of the 'loci as variables' view that all variables are realized as loci, only that loci spell out variables. We certainly have not refuted the variable-free view of loci laid out in Kuhn, to appear; but we have shown that a variable-full analysis can account for the same data as well as well ones Kuhn doesn't discuss, and we have suggested that the variable-free account would need to be extended not just to account for deictic loci, but also for the iconic bound loci discussed in Section 3. Finally, we have suggested that featural variables might exist in spoken languages as well, namely in the temporal domain.

[21] In general, standard constraints on variables should be added to account for Binding Theory (e.g. Büring 2005). In particular, an anonymous reviewer asks whether loci could be mismatched in examples such as (i)a, with the Logical form in (i)b – with loci *a* and *b* both referring to John. We believe our system should be constrained to block these. But in this case independent considerations might do so:

(i) a. IX-a JOHN_a TELL-ME IX-b WIN.
b. $\text{John}^a\ \lambda i^a\ t_i^a$ tell me pro_i^b win

In the Logical Form in (i)b, *i* is a bound variable, and *b* is a free variable that presuppositionally constrains the value of *i*. As long as *b* denotes John, no presupposition failure arises. But (i)b is arguably ruled out by a general principled called *Have Local Binding!,* which mandates that *salva veritate* variables should be bound by the most local antecedents possible. Since *b* could be replaced with a locally bound variable *a* or *i* without changing the truth conditions, this representation is presumably ruled out.

Appendix. Complement Set Anaphora and Loci As Variables[22]

We briefly discuss below an interpretive property of plural loci that can be analyzed within a variable-full system, but might not be trivial to handle in a pure agreement-based analysis. Plural loci are realized in ASL (and LSF) as semi-circular areas, which closely correspond to plural variables. Now in some cases one plural locus *a* can be embedded within a larger plural locus *ab*, with the result that a 'complement locus' *b* suddenly pops into existence, and denotes the complement of the denotation of *a* within the denotation of *ab*. An 'iconic' analysis was offered for this phenomenon in Schlenker et al. 2013, but it hinged rather crucially on a treatment of plural loci as variables that have a denotation.

To introduce the issue, we start with the English sentence *Most students came to class*. Recent research has argued that it makes available two discourse referents for further anaphoric uptake: one corresponding to the maximal set of students, as illustrated in (41)b ('maximal set anaphora'); and one for the entire set of students, as illustrated in (41)c ('restrictor set anaphora').

(41) a. *Complement set anaphora:* #Most students came to class. They stayed home instead.
b. *Maximal set anaphora:* Most students came to class, and they asked good questions.
c. *Restrictor set anaphora:* Most students came to class. They are a serious group.

By contrast, no discourse referent is made available for the set of students that *didn't* come to class ('complement set anaphora', as this is the complement of the maximal set within the restrictor set); this is what explains the deviance of (41)a (see Nouwen 2003 and Schlenker et al. 2013 for further discussion of apparent counterexamples).

On the basis of ASL and LSF data, Schlenker et al. 2013 made two main observations.

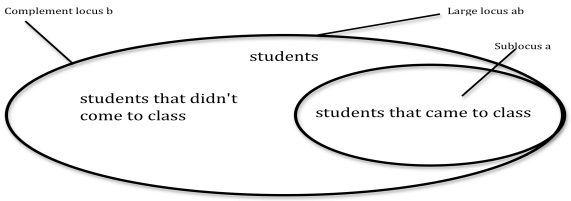
Observation I. When a default plural locus is used in ASL, data similar to (41) can be replicated – e.g. complement set anaphora with *most* is quite degraded.

Observation II. When embedded loci are used, the effect is circumvented: one large locus (written as *ab*, but signed as a single circular locus) denotes the set of all students; a sub-locus (= *a*) denotes the set of students who came; and a complement locus (= *b*) thereby becomes available, denoting the set of students who didn't come, as illustrated in (42) and (43).

[22] Part of this discussion borrows from Schlenker et al. 2013 and Schlenker 2015.

(42) 7 POSS-1 STUDENT IX-arc-ab MOST IX-arc-a a-CAME CLASS. IX-arc-a a-ASK-1 GOOD QUESTION.
'Most of my students came to class. They asked me good questions.'
(ASL; 8, 196)

(43)



Schlenker et al. 2013 account for Observation I and Observation II by assuming that (i) Nouwen is right that in English, *as well as ASL and LSF*, the grammar *fails* to make available a discourse referent for the complement set, i.e. the set of students who didn't come; but (ii) the mapping between plural loci and mereological sums preserves relations of inclusion and complementation, which in (42)a makes available the locus *b*.

The main assumptions are that (A1) the set of loci is closed with respect to relative complementation: if *a* is a sublocus of *b,* then *(b-a)* is a locus as well; and (A2) assignment functions are constrained to respect inclusion and relative complementation: if *a* is a sublocus of *b*, the denotation of *a* is a subpart of the denotation of *b,* and *(b-a)* denotes the expected complement set. In (42)a, where embedded loci are used, we can make the following reasoning:

• Since *a* is a proper sublocus of a large locus *ab*, we can infer (by assumption A1) that *(ab-a)* (i.e. *b*) is a locus as well.

• By assumption A2, we can also infer that s(a) ⊂ s(ab) and that s(b) = s(ab)-s(a).

In this way, complement set anaphora becomes available because ASL can rely on an iconic property which is inapplicable in English. For present purposes, what matters is that the locus *b* in (42)a and (43) is not inherited by way of agreement, since it is not introduced by anything. From a variable-full perspective, the existence of this locus is inferred by a closure condition on the set of loci, and its denotation is inferred by an iconic rule. But the latter makes crucial reference to the fact that loci have denotations. It is not trivial to see how this result could be replicated in a variable-free analysis in which loci don't have a denotation to begin with. One possibility is that the complement set locus should be treated as being deictic (which is the one case in which the variable-free analysis has an analogue of variable denotations). This might force a view in which complement set loci are handled in a diagrammatic-like fashion, with co-speech gestures/diagrams incorporated into signs – something that would require a more detailed investigation.

References

Büring, Daniel: 2005, *Binding Theory*. Cambridge: Cambridge University Press

Fox, Danny: 2000, *Economy and Semantic Interpretation,* MIT Press

Heim, Irene: 1991, 'The first person', Class handouts, MIT.

Heim, Irene: 1994, Comments on Abusch's Theory of Tense', in H. Kamp (ed.), *Ellipsis, Tense and Questions,* pp. 143-170, University of Amsterdam.

Heim, Irene: 2005, Features on bound pronouns: semantics or syntax? Unpublished manuscript, MIT.

Heim, Irene: 2008, Features on bound pronouns. In Daniel Harbour, David Adger, Susana Bejar (eds), *Phi-theory: Phi-features across modules and interfaces*, Oxford University Press.

Heim, Irene and Kratzer, Angelika: *Semantics in Generative Grammar*. Oxford (Basil Blackwell).

Jacobson, Pauline: 1999, 'Towards a variable-free semantics'. *Linguistics and Philosophy* 22:117–84.

Jacobson, Pauline: 2012, Direct Compositionality and 'Uninterpretability': The Case of (Sometimes) 'Uninterpretable' Features on Pronouns. *Journal of Semantics*, 29: 305–343

Kuhn, Jeremy: to appear, ASL Loci: Variables or Features? To appear in *Journal of Semantics*.

Kratzer, Angelika: 2009, Making a pronoun: Fake indexicals as windows into the properties of pronouns. *Linguistic Inquiry*, 40(2), 187–237.

Lillo-Martin, Diane and Klima, Edward S.: 1990, Pointing out Differences: ASL Pronouns in Syntactic Theory. In Susan D. Fischer & Patricia Siple (Eds.), *Theoretical Issues in Sign Language Research*, Volume 1: Linguistics, 191-210. Chicago: University of Chicago Press.

Meier, Richard: 1990. Person deixis in American Sign Language. In *Theoretical Issues in Sign Language Research,* eds. Susan D. Fischer and Patricia Siple, 175-190. Chicago: University of Chicago Press.

Meier, Richard: 2012, Language and Modality. In: Roland Pfau, Markus Steinbach, & Bencie Woll (eds.), *Handbook of Sign Language Linguistics*. Berlin: Mouton de Gruyter

Merchant, Jason: 2014, Gender mismatches under nominal ellipsis. Lingua 2014, http://dx. doi.org/10.1016/j.lingua.2014.01.008

Percus, Orin: 2006, Antipresuppositions. In Ueyama, U. (ed), Theoretical and Empirical Studies of Reference and Anaphora: Toward the establishment of generative grammar as empirical science, pp. 52–73: Japan Society for the Promotion of Science. Report of the Grant-in-Aid for Scientific Research. Also available at Semantic Archive.

Reuland, Eric: 2011, *Anaphora and language design*. MIT Press.

Rooth, Mats: 1996, Focus. In Lappin, S., editor, *Handbook of Contemporary Semantic Theory*, pages 271–297. Blackwell, Oxford.

Sandler, Wendy and Lillo-Martin, Diane: 2006, *Sign Language and Linguistic Universals*. Cambridge University Press.

Schlenker, Philippe: 1999, *Propositional Attitudes and Indexicality: a Cross-Categorial Approach*. Doctoral dissertation, MIT.

Schlenker, Philippe: 2003, A Plea for Monsters, *Linguistics & Philosophy* 26: 29-120

Schlenker, Philippe: 2005, Non-Redundancy: Towards A Semantic Reinterpretation of Binding Theory, *Natural Language Semantics* 13, 1:1-92

Schlenker, Philippe: 2009, Local Contexts. *Semantics & Pragmatics,* Volume 2, Article 3: 1-78, doi: 10.3765/sp.2.3

Schlenker, Philippe: 2011, Donkey Anaphora: the View from Sign Language (ASL and LSF). *Linguistics and Philosophy* 34, 4: 341-395

Schlenker, Philippe: 2013, Temporal and Modal Anaphora in Sign Language (ASL).

Natural Language and Linguistic Theory 31, 1: 207-234.
Schlenker, Philippe: 2014, Iconic Features. *Natural Language Semantics* 22, 4: 299-356.
Schlenker, Philippe: 2015, Sign Language and the Foundations of Anaphora. Manuscript, Institut Jean-Nicod and New York University.
Schlenker, Philippe: to appear, Gestural Presuppositions (squib). Accepted for publication in *Snippets*.
Schlenker, Philippe, Lamberton, Jonathan and Santoro, Mirko: 2013, Iconic Variables. *Linguistics & Philosophy* 36, 2, 91-149.
Spathas, Giorgos: 2007, Interpreting gender features on bound pronouns. NELS 38.
Stechow, Arnim von. 2004. Binding by Verbs: Tense, Person and Mood under Attitudes. In The Syntax and Semantics of the Left Periphery, eds. Horst Lohnstein and Susanne Trissler, 431 – 488. Berlin – New York: Mouton de Gruyter.
Sudo, Yasutada: 2013, *On the Semantics of Phi Features on Pronouns*. Ph.D. dissertation, MIT.
Wechsler, Stephen 2010. 'What "You" and "I" Mean to Each Other: Person Marking, Self-Ascription, and Theory of Mind.' *Language*. 86.2, pp. 332-365.