Three Kinds of Iconicity in Sign Language Pronominals: A Formal Approach

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Goals

- **Two faces of sign language**

  a. **Formal Face:** sign language is a formal symbolic system with phonological, morphological, syntactic and semantic rules comparable to those of spoken language.

  b. **Iconic Face:** sign language allows for a gradient mapping between geometric properties of signs and the meanings they express.

  => the field is sharply divided between 'formalists', who emphasize (a), and anti-formalists, who emphasize (b).

- a. **Claim:** the Formal face and the Iconic face can be reconciled within a formal semantics with iconicity.

  b. **Application:** loci are both formal variables and simplified pictures of what they denote.

Loci as Formal Indices
(Lillo-Martin and Klima 1990)

	Spoken Languages	Sign Languages
Person/number distinctions	• 1st, 2nd, 3rd.. • Dual, plural...	ASL: 1st, dual, plur LSF: dual, plural...
Ambiguity without ellipsis	Sarkozy$_1$ told Obama$_2$ that he$_{1/2}$ would win.	ASL: overt indices LSF: overt indices
Ambiguity with ellipsis	Peter$_1$ loves his$_1$ wife. John$_2$ does too.	ASL: Yes LSF: Yes
Conditions A and B	*John$_1$ likes him$_1$ John$_1$ likes himself$_1$	ASL: Yes (but…) LSF: Yes (but…)
Strong Crossover	*Who$_1$ does he$_1$ think that I like t$_1$?	ASL: Yes (but...) LSF: ?

Loci as Pictures (Liddell 2003)

- **Directional verbs target loci**

  a. Lillo-Martin 1991 and Lillo-Martin and Meier 2011: they are associated with null pronominals.

  b. Liddell 2003, 2011: **they are associated with simplified pictures of their arguments**.

- **Liddell 2003 on Structured Loci**

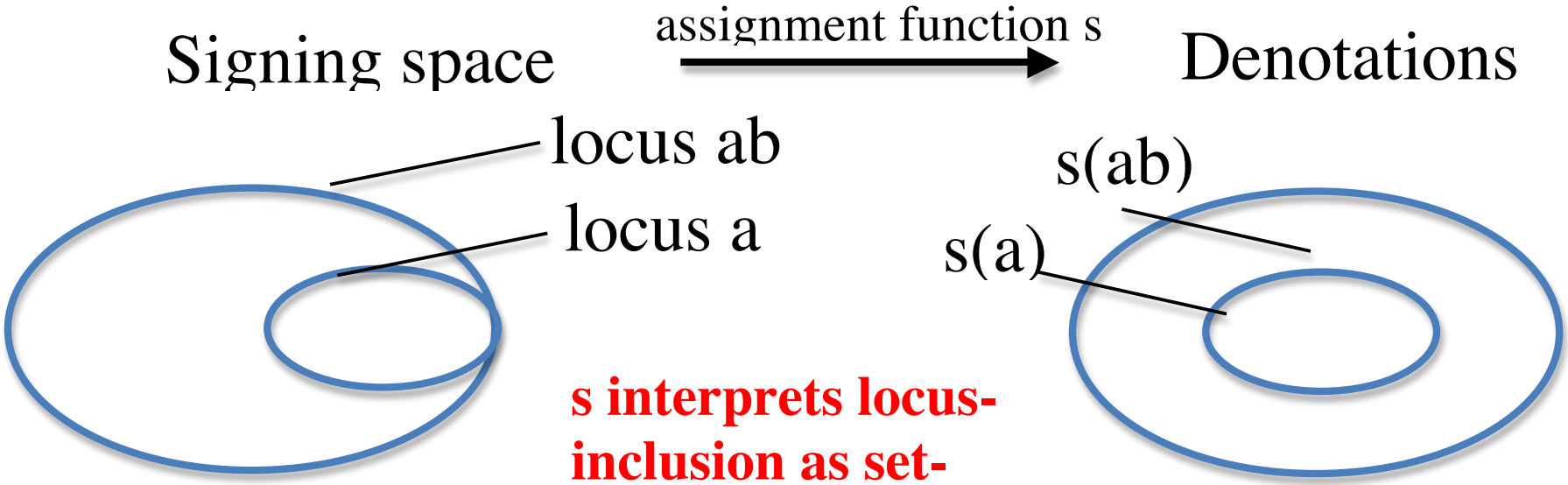
  "Each individual verb has specific gestural characteristics associated with it. (...) For those that do point, if they are directed at a person, they are directed at specific parts of the person (e.g. forehead, nose, chin, sternum). These are not general characteristics of gestural 'accompaniments' to signing. These are specific, semantically relevant, properties of individual verbs."

Proposal

- a. Loci are formal indices...
  b. but the interpretation function obeys iconic requirements.

- **Formal iconicity = some geometric properties of signs must be preserved by the interpretation function**

- **Example:** subloci



s interprets locus-inclusion as set-theoretic inclusion

Roadmap: 3 kinds of formal iconicity

- **Structural iconicity:**
  Complement set Anaphora
  #Most students came to class. They stayed home instead.
  => The effect can be replicated or obviated in SL depending on how much iconicity is used to represent the meaning.

- **Locus-external iconicity:**
  high loci denote tall or powerful entities

- **Locus-internal iconicity:**
  directional verbs target different parts of a locus

Elicitation Method

- **Native signers** of ASL and LSF (of deaf, signing parents). So far: 1 or 3 ASL informants; 1 or 2 LSF informants.

- **Playback method**

  Stage 1: One signer **signs** sentences of interest, as part of **paradigms** taped on a single video.

  Stage 2: The signer immediately **assess** the videos for acceptability (usually by comparing several sentences), using **ratings on a 7-point scale** (below we provide raw scores).

  Stage 3: Stage 2 is usually repeated with the same informant and/or with different informants, often multiple times.

- **Advantages:** (i) quantitative, controlled judgments; (ii) repeatability; (iii) Stage 3 is uncontaminated by English.

Structural Iconicity

Maximal Set and Restrictor Set Anaphora

- **Maximal Set Anaphora**

  a. Few students came to class, but they asked good questions.

  b. Most students came to class, and they asked good questions.

  => *they* may denote the maximal group of students that came to class

- **Restrictor Set Anaphora**

  a. Few students came to class. They aren't a serious group.

  b. Most students came to class. They are a serious group.

  => *they* may denote the group of all students

Complement Set Anaphora

- **Complement Set Anaphora**

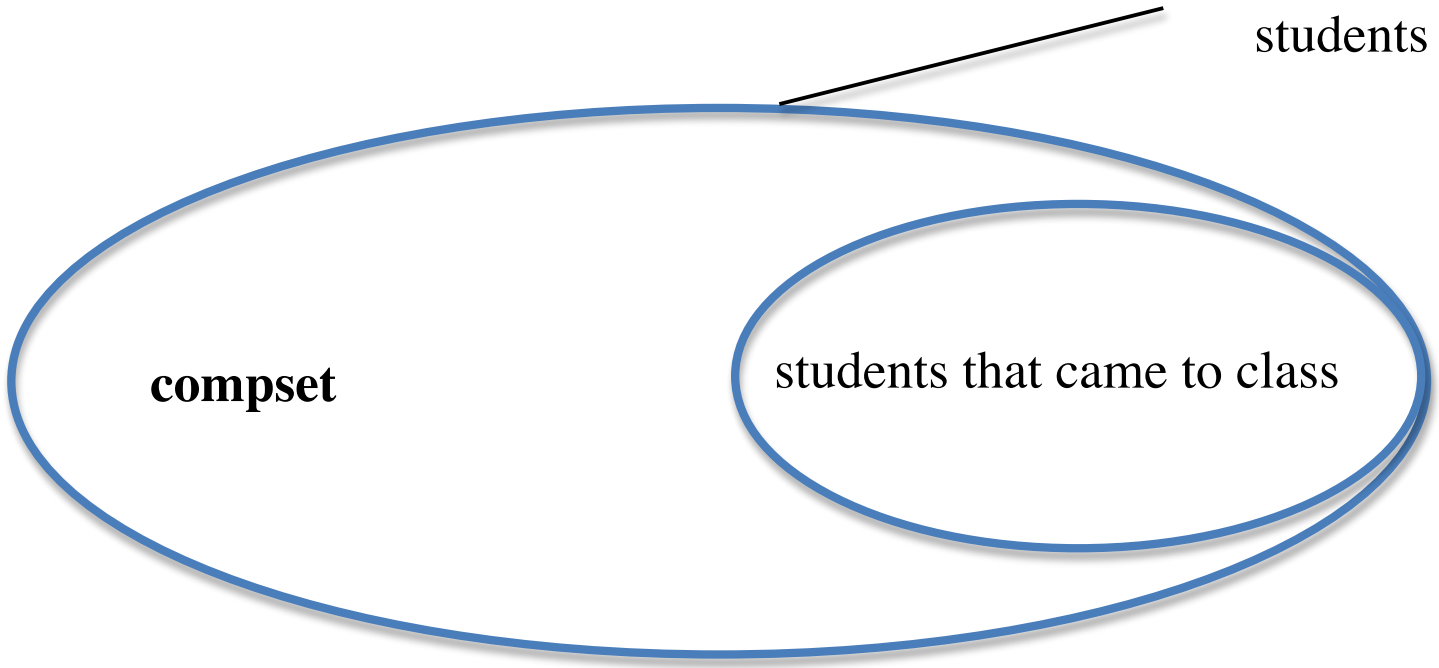
  a. ?Few students came to class. They stayed home instead.

  b. #Most students came to class. They stayed home instead.

  => *they* can't really denote the students who did *not* come

  [a. involves inference and/or a collective readings]

  => Nouwen 2003: no discourse ref for the Complement Set



[Default Locus:
Ok Maximal and Restrictor Set Anaphora]

- **Maximal Set Anaphora**

  6 POSS-1 STUDENT MOST **a**-CAME CLASS.
  IX-arc-a **a**-ASK-1 GOOD QUESTION
  'Most of my students came to class. They asked good questions'. (Inf 1, 8, 200; 8, 201; 8 205; 8, 223)

- **Restrictor Set Anaphora**

  6.7 POSS-1 STUDENT **IX-arc-a** MOST **a**-CAME CLASS.
  IX-arc-a SERIOUS CLASS.
  'Most of my students came to class. They are a serious class.'
  (Inf 1, 8, 200; 8, 201; 8 205; 8, 223)

Default Locus: *Complement Set Anaphora

- **Complement Set Anaphora: degraded**

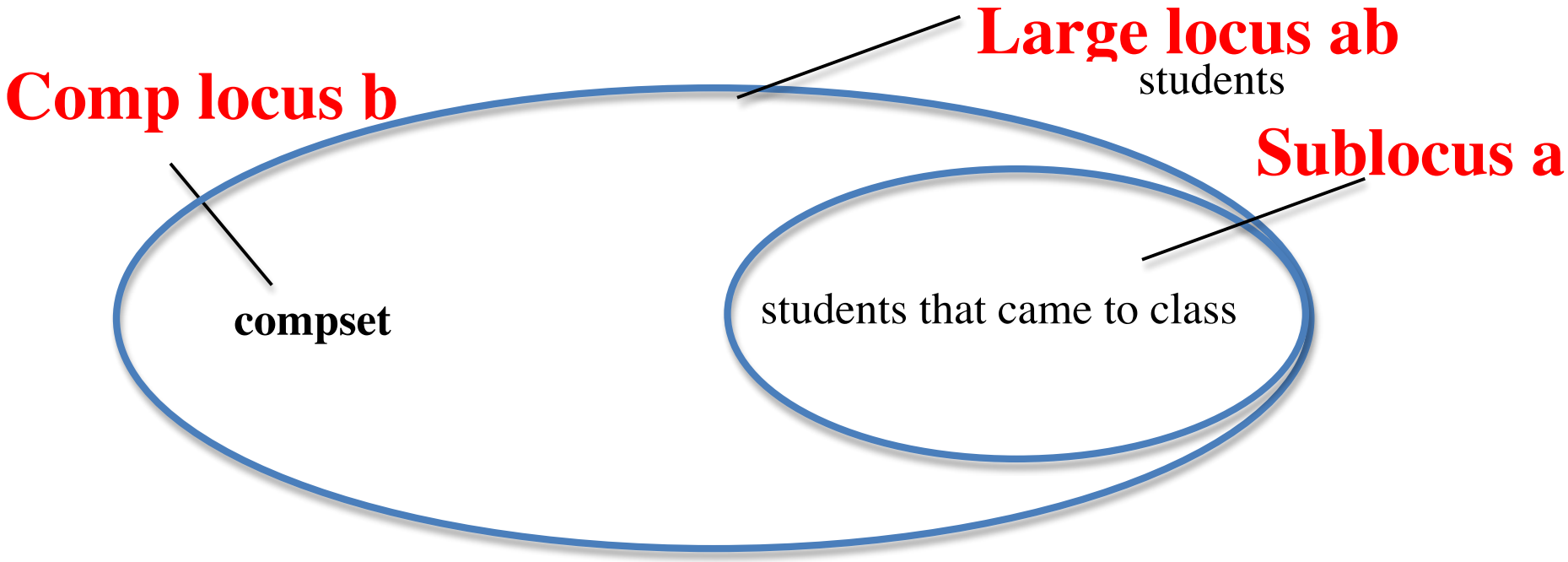
  a. 2.8 POSS-1 STUDENT MOST **a**-CAME CLASS.
  IX-arc-a a-STAY HOME
  Intended: 'Most of my students came to class. Those who didn't come stayed home.'

  b. 3.6 POSS-1 STUDENT FEW **a**-CAME CLASS.
  IX-arc-a a-STAY HOME
  Intended: 'Few of my students came to class. Those who didn't come stayed home.'
  (Inf 1, 8, 225; 8, 226; 8, 285; 8, 300; 8, 305; 8, 348)

- **5 trials, 3 by Inf 1 + 1 by 2 additional consultants**
  Equal weight to all trials

Embedded Loci: [Ok] Complement Set Anaphora

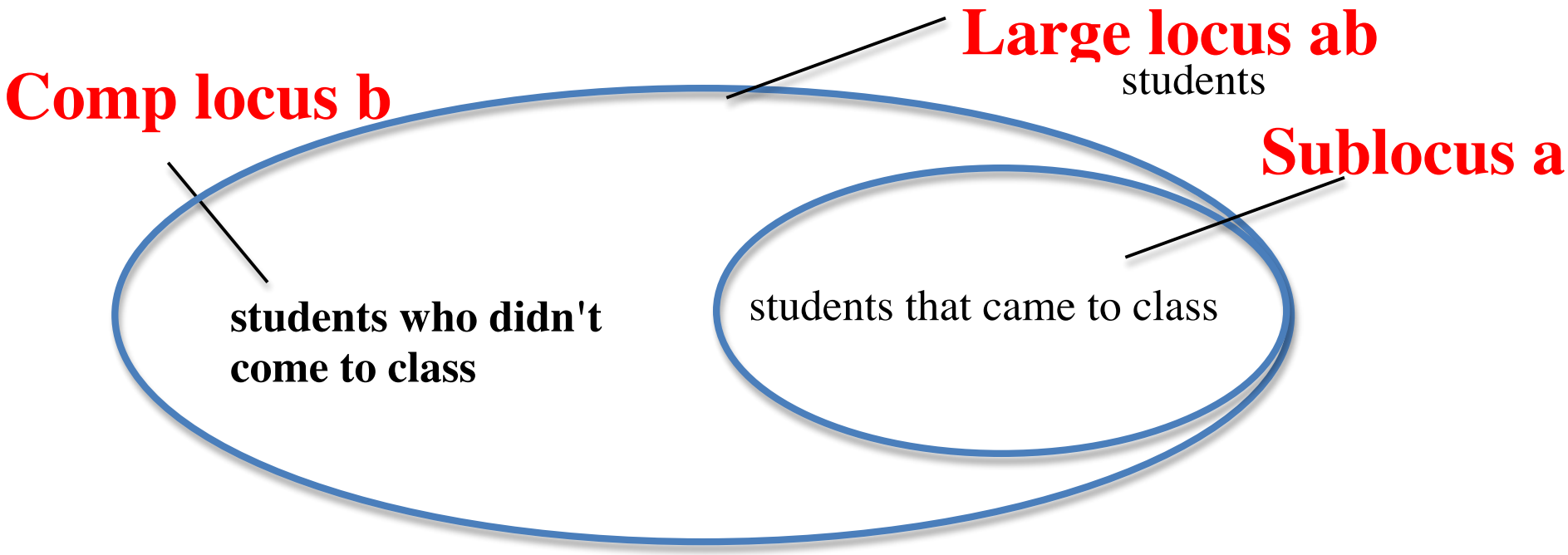
- POSS-1 STUDENT IX-arc-ab MOST IX-arc-a a-CAME CLASS.
  a. 7 IX-arc-b b-STAY HOME
  b. 7 IX-arc-a a-ASK-1 GOOD QUESTION
  c. 7 IX-arc-ab SERIOUS CLASS



Obviating the Effect: Embedded Loci

- Context: I teach a linguistics class at NYU.
  a. **6.7** POSS-1 STUDENT **IX-arc-ab** FEW **IX-arc-a** a-CAME. **IX-arc-b** b-STAY HOME

  b. **6.3** POSS-1 STUDENT **IX-arc-ab** MOST **IX-arc-a** a-CAME. **IX-arc-b** b-STAY HOME



[Obviating the Effect: Embedded Loci]

- Context: I teach a linguistics class at NYU.
  a. **6.7** POSS-1 STUDENT **IX-arc-ab** FEW **IX-arc-a** a-CAME. **IX-arc-b** b-STAY HOME

  b. **6.3** POSS-1 STUDENT **IX-arc-ab** MOST **IX-arc-a** a-CAME. **IX-arc-b** b-STAY HOME

- **3.6** POSS-1 STUDENT FEW **a**-CAME CLASS. **IX-arc-a** a-STAY HOME
  d. **2.8** POSS-1 STUDENT MOST **a**-CAME CLASS. **IX-arc-a** a-STAY HOME
  'Few/Most of my students came to class. They stayed home.'
  (Inf 1, 8, 225; 8, 226; 8, 285; 8, 300; 8, 305; 8, 348)

- **5 trials, 3 by Inf 1 + 1 by 2 additional consultants**
  Equal weight to all trials

Proposal: Structural Iconicity

- Let LOC be the set of plural loci that appear in signing space, and let s an admissible assignment function that assigns values to all loci.

- **a. Closure of LOC under relative complementation**
  For all a, b ∈ LOC,
  (i) a ⊆ b or b ⊆ a or a ∩ b = Ø;
  (ii) if a ⊂ b, (b-a) ∈ LOC

  b. Structural Iconicity of the assignment function s
  For all a, b ∈ LOC,
  (i) a ⊂ b iff s(a) ⊂ s(b);
  (ii) if a ⊂ b, s(b-a) = s(b)-s(a)

Proposal: Complement Set Anaphora

- **Nouwen's Suggestion (2003):** Grammar makes available a discourse referent for the Maximal Set and the Restrictor Set, but none for the Complement Set (... unless it is inferred).

- **Single Default Locus: ASL ≈ English**

- **Embedded Loci: ASL ≠ English.**
  Account = Nouwen's analysis + structural iconicity, i.e.:
  (i) Loci: if a locus **ab** and a sublocus **a** are established, the complement locus **b** thereby comes into existence;
  (ii) Denotations: the assignment function s respects complementation: **s(b) = s(ab - a) = s(ab) - s(a)**

- **Conclusion: Complement Set anaphora is made possible by structural iconicity.**

[Replicating the effect in LSF]

- **Single locus** 21, 10; 11; 25 [1 informant]
  STUDENT POSS-1 $MOST_a$ CLASS a-COME-rep.
  a. IX-arc-a HOME STAY. **4 3**
  b. IX-arc-a a-ASK-QUESTION-1-rep GOOD. 7 7
  c. IX-arc-a CLASS SERIOUS 7 7

- **Embedded loci** 21, 6; 7; 23 [1 informant]
  STUDENT POSS-1 IX-arc-ab $MOST_a$ CLASS a-COME-rep.
  a. IX-arc-b HOME STAY. 7 7
  b. IX-arc-a a-ASK-QUESTION-1-rep GOOD. 7 7
  c. IX-arc-ab CLASS SERIOUS. 6 6

Locus-external Iconicity

High and Low Loci: Inferences

- YESTERDAY IX-1 SEE R [= body-anchored proper name]. IX-1 **NOT** UNDERSTAND IX-a$^{\text{high / normal / low}}$
  'Yesterday I saw R [= body-anchored proper name]. I didn't understand him.'

  a. High locus. Inference: R is tall, or powerful/important

  b. Normal locus. Inference: nothing special

  c. Low locus. Inference: R is short

  11, 24; 25

- The inference survives under negation => it might be presuppositional.

  John stopped smoking => John used to smoke

  John didn't stop smoking => John used to smoke

[High and Low Loci: Bound Examples]

- NO GIANT THINK IX-1 LIKE IX-a (11, 26; 30)
  a. High: 7
  b. Normal: 5
  c. Low: 2

- NO TALL MAN THINK IX-1 LIKE IX-a (11, 27; 31)
  a. High: 7
  b. Normal: 6
  c. Low: 3

- NO DWARF THINK IX-1 LIKE IX-a (11, 28; 32)
  a. High: 2
  b. Normal: 6
  c. Low: 7

Presuppositional Analysis: Gender

- Let c be a context of speech and s be an assignment function (c_a denotes the author of c, i.e. the signer).

  a. If *f* is a feminine feature and *i* is in index,

  $[[\text{pro-f}_i]]^{c,s,w}$ = # iff s(i) = # or **s(i) is not female in c**.
  If $[[\text{pro-f}_i]]^{c,s,w} \neq \#$, $[[\text{pro-f}_i]]^{c,s,w}$ = s(i).

- The inference is presuppositional: it projects out of negation

  a. I don't understand her_i
  => s(i) is female.

  b. No very tall woman thinks that I like her / #him
  => the quantifier must range over female individuals.

Presuppositional Analysis: Gender vs. Height

- Let c be a context of speech and s be an assignment function (c_a denotes the author of c, i.e. the signer).

  a. If *f* is a feminine feature and *i* is in index,

  $[[\text{pro-f}_i]]^{c,s,w}$ = # iff s(i) = # or **s(i) is not female in c**.
  If $[[\text{pro-f}_i]]^{c,s,w} \neq \#$, $[[\text{pro-f}_i]]^{c,s,w}$ = s(i).

  b. Powerful and tall entities have high loci (1st try)
  If *i* is a locus that appears high in the signing space,

  $[[\text{IX-i}]]^{c,s,w}$ = # iff s(i) = # or **s(i) is not tall or powerful relative to the signer c_a in c**.
  If $[[\text{IX-i}]]^{c,s,w} \neq \#$, $[[\text{IX-i}]]^{c,s,w}$ = s(i).

Context Dependency

- **The indexical nature of gender features**

  $[[\text{pro-f}_i]]^{c,s,w}$ = # iff s(i) = # or **s(i) is not female in c**.
  If $[[\text{pro-f}_i]]^{c,s} \neq \#$, $[[\text{pro-f}_i]]^{c,s} = s(i)$.

- Bill wore a dress and make-up and John didn't realize that he was a man. He said that he/#she looked great and that he/#she was staring at him. (Sharvit 2008)

- he/#she is evaluated with respect to the context of speech, NOT John's belief worlds.

Context Dependency

- **The indexical nature of height specifications**

  [[IX-i]]$^{c, s, w}$ = # iff s(i) = # or **s(i) is not tall or powerful relative to the signer c_a in c**. If [[IX-i]]$^{c, s} \neq$ #, [[IX-i]]$^{c, s}$ = s(i).

- POSS-1 COUSIN IX-a **WRONGLY THINK** POSS-1 YOUNG BROTHER TALL. IX-a THINK IX-b$^{high/normal/low}$ BASKETBALL PERSON.
  'My cousin wrongly think that my younger brother is tall. He thinks he is a basketball player.'

a. High locus	**3**	**3**
b. Normal locus	7	7

10, 66; 67

Context Dependency

- POSS-1 COUSIN IX-a **KNOW** POSS-1 YOUNG BROTHER TALL. IX-a WRONGLY THINK IX-b$^{high/normal/low}$ BASKETBALL PERSON.

  'My cousin knows that my younger brother is tall. He wrongly thinks he is a basketball player.'

  a. High locus **7** **7**

  b. Normal locus 7 7

  10, 68; 69

A subtle contrast: English

- a. Bill wore a dress and make-up and John didn't realize that he was a man. He said that he/#she looked great and that he/#she was staring at him. (Sharvit 2008)

  he/#she is evaluated with respect to the context of speech, NOT John's belief worlds.

  b. My students wrongly think that I have a sister, and they are convinced that #he/she is basketball player.

  he/#she is NOT evaluated with respect to the context of speech.

- We do not seek to *explain* the contrast... but to test it in ASL.

A subtle contrast: ASL

- a. POSS-1 BROTHER SHORT BUT POSS-1 STUDENT IX-arc-a THINK POSS-1 BROTHER TALL. IX-arc-a THINK IX-a$^{\text{high / normal}}$ BASKETBALL PERSON.
  'My brother is short, but my students think my brother is tall. They think he is a basketball player.'

1. High locus:	**4**	**3**	**5**	**4**
2. Normal locus:	**7**	**7**	**7**	**7**

b. IX-1 HAVE NO BROTHER, BUT STUDENT IX-arc-a THINK IX-1 HAVE TALL BROTHER. IX-arc-a THINK IX-b$^{\text{high / normal}}$ BASKETBALL PERSON.
'I have no brother, but my students think I have a tall brother. They think he is a basketball player.'

1. High locus:	**7**	**7**	**7**	**7**
2. Normal locus:	**6**	**4**	**7**	**7**

10, 81; 82; 96; 11, 22

An Iconic Analysis

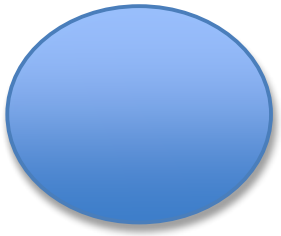
- Powerful and tall entities have high loci (1st try)
  If *i* is a locus that appears high in the signing space,

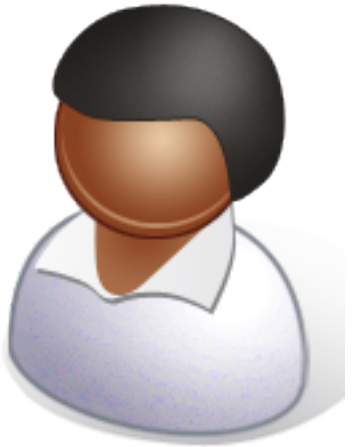
  $[[\text{IX-i}]]^{c,s,w}$ = # iff s(i) = # or s(i) is not tall or powerful relative to the signer c_a in c. If $[[\text{IX-i}]]^{c,s,w} \neq$ #, $[[\text{IX-i}]]^{c,s,w}$ = s(i).

- Powerful and tall entities have high loci (2nd try)
  If *i* is a locus that appears high in the signing space,

  $[[\text{IX-i}]]^{c,s,w}$ = # iff s(i) = # or <1, i> is not iconically projectable to <c_a, s(i)> along the 'power' or 'height' dimension. If $[[\text{pro-i}]]^{c,s,w} \neq$ #, $[[\text{pro-i}]]^{c,s,w}$ = s(i).

locus i





locus 1

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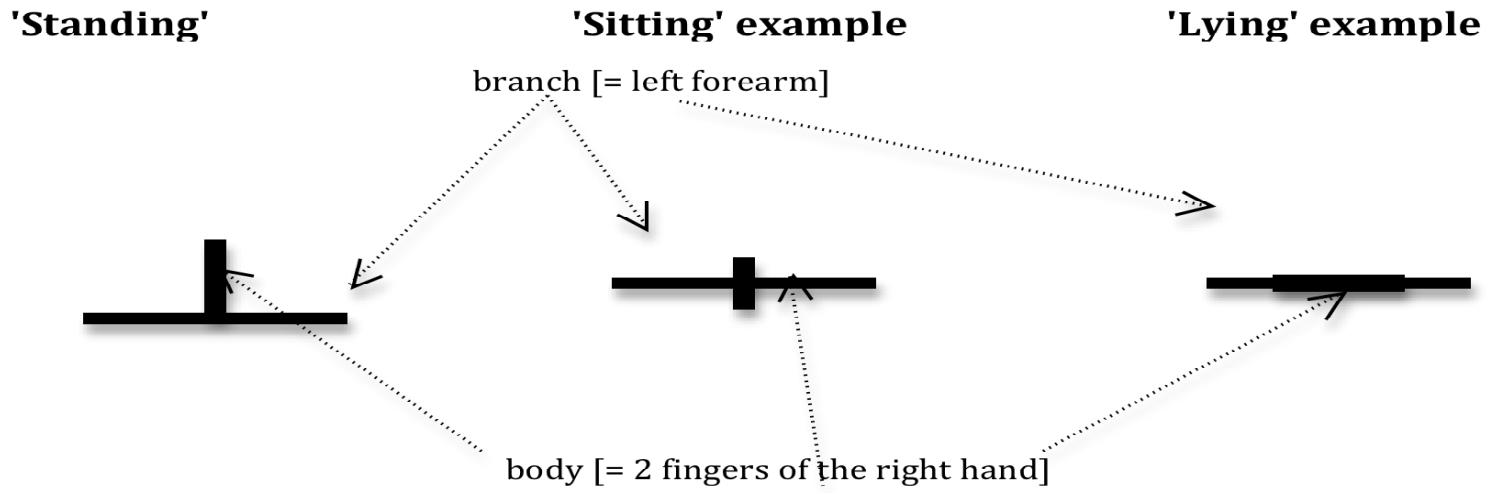
Testing the Iconic Analysis

- a. On the non-iconic analysis, height specifications should be independent from the position of the body referred to.

  b. On the iconic analysis, height specifications should depend on the position of the body referred to.

- Test with three positions: standing, lying, hanging



Combining Iconicity and Reflexivity: Standing

- **Standing / Sitting / Lying**

1. 10, 110;113; 138; 11, 19 2. 10, 111; 114; 139; 11, 20. 3.10, 112;115; 140; 11, 21

Context: People seek self-knowledge in the weirdest of situations.
YESTERDAY VERY TALL PHILOSOPHER PERSON
1. $STAND_a$
2. SIT_a
3. LIE_a

PARK. SUDDENLY IX-$a^{high / normal / low}$ UNDERSTAND IX-$a^{high / normal / low}$ / SELF-$a^{high / normal / low}$
'Yesterday a very tall philosopher was standing / sitting / lying in the park. Suddenly he understood him / himself.'

Combining Iconicity and Reflexivity

	Standing	Sitting	Lying
1. High			
a. IX:	2 3 1	1 2 1	1 2 1
b. SELF:	**6 6 6**	3 5 5	2 3 3
2. Medium			
a. IX:	3 4 2	3 3 2	3 3 2
b. SELF:	**7 7 7**	**7 7 7**	**7 7 7**
3. Low			
a. IX:	1 2 1	2 2 1	2 3 1
b. SELF:	3 3 4	5 4 5	**6 6 7**

[Replicating the main effect in LSF]

- **Presuppositional inferences** 21, 46; 47

  YESTERDAY IX-1 SEE JEAN. IX-1 LIKE IX-a$^{\text{high / normal / low}}$

  NOT

  a. High locus

  6; => Jean is taller, older/more powerful than the speaker

  b. Normal locus

  7; => same height?

  c. Low locus

  6; => Jean is a child or is short

[Replicating the main effect in LSF]

- **Bound high loci** 21, 42; 43

  EACH-rep GIANT THINK NOBODY LIKE IX-a$^{\text{high / normal / low}}$.

  a. High locus 7
  b. Normal locus 2
  c. Low locus 1

- **Bound low loci** 21, 44; 45

  EACH-rep DWARF THINK NOBODY LIKE IX-a$^{\text{high / normal / low}}$.

  a. High locus 1
  b. Normal locus 3
  c. Low locus 7

Locus-internal Iconicity

The Debate

- **Liddell 2003:** loci should be seen as simplified pictures of what they represent.
  => loci targeted by directional verbs are pictures

- **Lillo-Martin and Meier 2011:** directional verbs are agreement constructions and license null pronouns.
  => loci targeted by directional verbs are (linked to) variables

- **Plan**

  a. Re-iterate that Liddell's facts hold when ASL and LSF directional verbs involve variables dependent on quantifiers.

  b. Develop a formal semantics in which both sides are right: loci are variables AND simplified pictures of what they denote

[Structured Loci: Directional Verbs]

- **ASK vs. COMMUNICATE TELEPATHICALLY: 1-2**
  YESTERDAY THE-TWO-1,2 MEET. THE-TWO-1,2
  ASK-QUESTIONS COMMUNICATE-BY-TELEPATHY
  (Inf 1, 8, 322-3)

Condition:	1. ASK-QUESTIONS	2. TELEPATHY
a. high	3	7
b. medium high	7	4
c. medium low	6	2
d. low	2	1

[Structured Loci: Directional Verbs]

- **ASK vs. COMMUNICATE TELEPATHICALLY: 3-3**

YESTERDAY [LINGUIST PERSON]$_a$ MEET [PHILOSOPHY PERSON]$_b$. THE-TWO-a,b

(RS$_a$_____)

ASK-QUESTIONS **COMMUNICATE-BY-TELEPATHY**

(Inf 1, 8, 320-1)

Condition:	**1. ASK-QUESTIONS**	**2. TELEPATHY**
a. high	5	7
b. medium high	**6**	**4**
c. medium low	**7**	**2**
d. low	3	1

[Structured Loci: Locus Orientation]

- *Context:* Several of my friends were hanging from a branch.

  TREE BRANCH CHEST-HIGH. SEVERAL POSS-1 FRIEND

  1. HANG HANG HANG

  2. STAND STAND STAND STAND (Inf 1, 9, 8-10; 9, 9-11)

  ONE_a TELL IX-1 IX-a WANT IX-1 1-ASK-a 1-ASK-a

Condition:	**1. Hanging**	**2. Standing**
a. High IX-a and a	**3, 4**	**7, 7**
b. Medium IX-a and a	**5, 6**	**7, 7**
c. Low IX-a and a	**7, 7**	**2, 2**

LSF: Structured Loci

- YESTERDAY LINGUIST$_b$ PHILOSOPHER$_a$ b,a-MEET.
  1. b,a-EXCHANGE
  2. b,a-COMMUNICATE-BY-TELEPATHY

  'Yesterday, a linguist and a philosopher met. They
  1. exchanged thoughts
  2. communicated by telepathy.'

  (19, 68 Inf H; 19, 69 Inf H; 19, 86 Inf I; 19, 96 Inf I; 19, 97 Inf H; 19, 146 Inf J; 19, 156 Inf J; 20, 158 Inf H)

LSF: Structured Loci

- Average per judgment

  YC: 3 judgments LD: 2 judgments IC: 2 judgments

- a. **High locus**

1. EXCHANGE	2.4	1 1 2 4 2 3 4
2. TELEPATHY	5.9	7 5 6 7 7 4 5

b. **Intermediate locus**

1. EXCHANGE	6.4	7 5 6 7 7 7 6
2. TELEPATHY	3.6	3 1 5 4 2 7 3

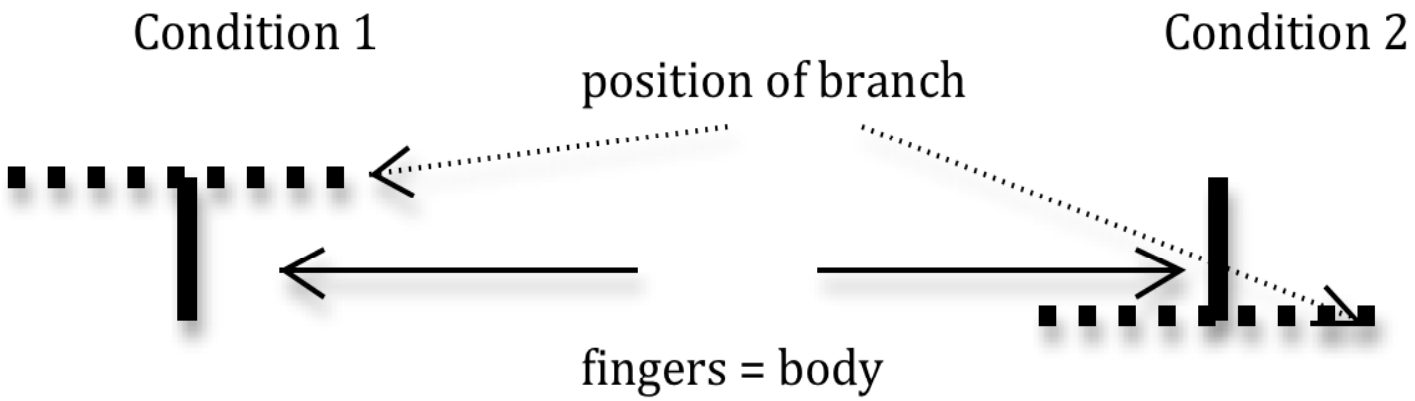
c. **Low locus**

1. EXCHANGE	1.7	1 2 1 1 1 2 4
2. TELEPATHY	1.1	1 1 1 1 1 1 2

LSF: Orientation Argument

- TREE BRANCH FRIEND MY SEVERAL
  1. HANG-rep / 2. STAND-rep
  IX-a WANT IX-1 **1-ASK-a**$^{\text{high / medium / low}}$-rep.

  'Several of my friends were 1. hanging from 2. standing on a tree branch. One of them wanted me to ask him questions.'
  (Inf J 20, 9; Inf J 20, 10; Inf H 20, 167)



LSF: Orientation Argument

- 2 informants: YC, LD

- a. High
  1. HANG 2 2
  2. STAND **5 6**

  b. Normal
  1. HANG **6 7**
  2. STAND 2 4

  c. Low
  1. HANG 2 3
  2. STAND 1 1

[Future Work]

- **ASL:** *COMMUNICATE-BY-TELEPATHY* isn't very good with a third person plural subject; *THINK COMMUNICATE-BY-TELEPATHY* must be used instead. To circumvent this problem, a small Role Shift was used in our third person example.

- **ASL:** Similar data without this complexity can be obtained by comparing *LOOK* and *ASK* or *EXCHANGE*. But the data appear to be more subtle than with *COMMUNICATE-BY-TELEPATHY*.

- A crucial prediction has not been confirmed or refuted: in the 'hanging' position, *ASK-QUESTIONS* should target a **higher** position than *COMMUNICATE-BY-TELEPATHY*.

Locus-internal Iconicity

- **Agreement verbs**

  a. Syntax (Lillo-Martin and Meier 2011)

  They (i) carry agreement (ii) can license null pronouns.

  b. Semantics

  Agreement will be given a presuppositional semantics.

- **Semantics**

  a. Assignment functions assign values to **areas** of space rather than to **points** of space.

  b. Technically, we use

  lower font letters (e.g. i) to designate point-loci;

  capital letters (e.g. I) to designate area loci

  => assignment functions assign values to capital letters.

Presuppositional Treatment of Person / Height

- For any objects x and y of type e, for any context c and assignment function s,

  $[[\text{am\_working}]]^{c,s}(x) = \#$ iff x = # or **$x \neq c_a$**

  i.e. failure if the argument x doesn't denote the speaker

  If $[[\text{am\_working}]]^{c,s}(x) \neq \#$, = 1 iff x is working.

- **Basic idea:** we can extend this kind of analysis to height requirements of different directional verbs
  => **i-ASK-QUESTIONS-j** contains pronominal elements, with a requirement that they target 'chin'-level positions of a locus.

[Locus-internal Iconicity]

- For any objects x and y of type e, for any context c and assignment function s,

  [[i-ASK-QUESTIONS-j]]^{c,s}(y)(x) = # iff x = # or y = # or s(J) ≠ y or s(I) ≠ x or <I, i> is not iconically projectable to <body(s(I)), chin(s(I))> along the 'position' dimension or

  <J, j> is not iconically projectable to <body(s(J)), chin (s(J))> along the 'position' dimension.
  i.e. failure if <area locus, point locus> is not iconically projectable to <body, chin>

  If ≠ #, [[i-ASK-QUESTIONS-j]]^{c,s}(y)(x) = 1 iff x ask questions to y.

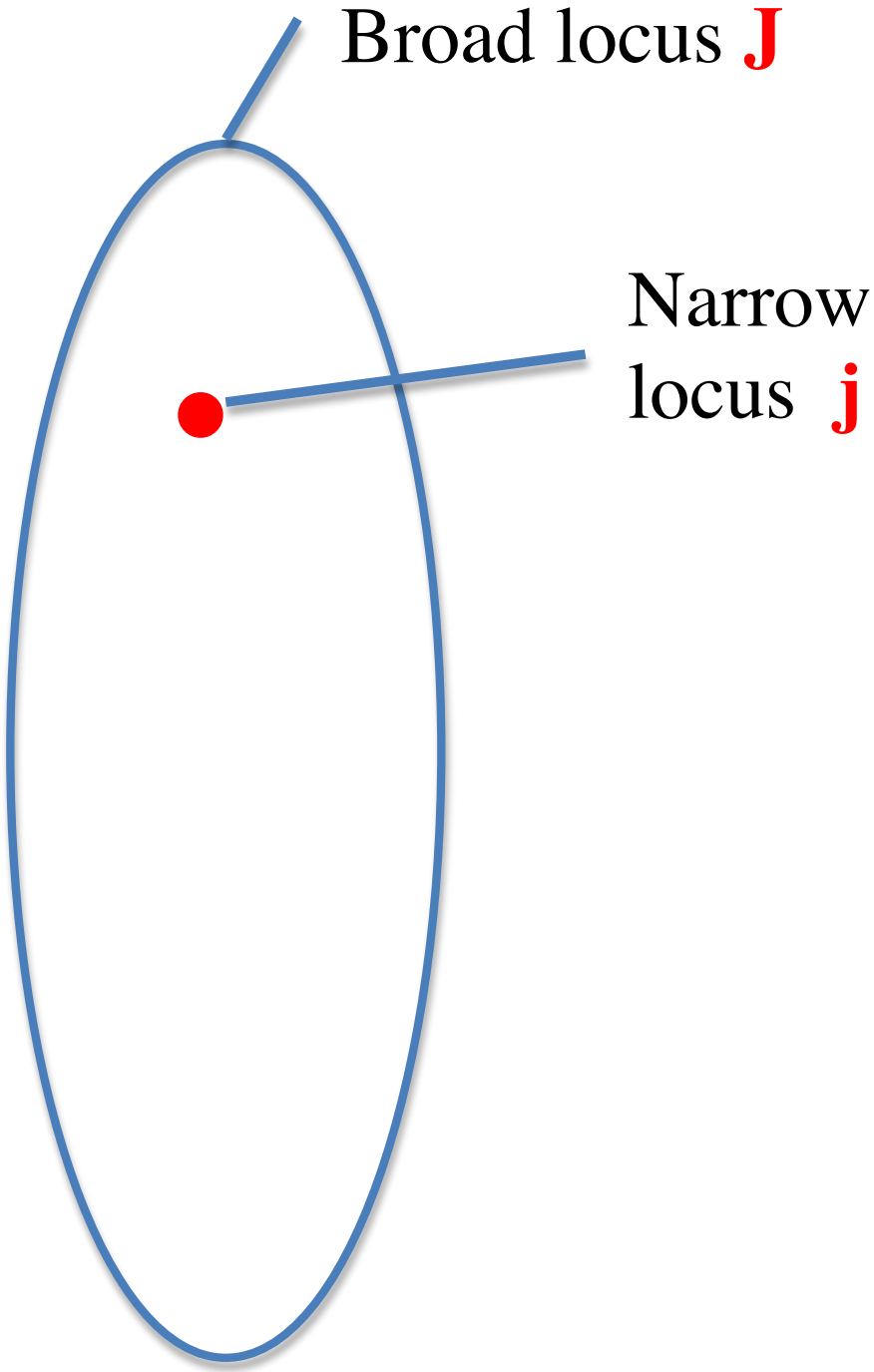
[Locus-internal Iconicity]

- For any objects x and y of type e, for any context c and assignment function s,

  [[i-j-COMMUNICATE-BY-TELEPATHY]]$^{c, s}$(y)(x) = # iff x = # or y = # or s(J) ≠ y or s(I) ≠ x or <I, i> is not iconically projectable to <body(s(I)), forehead(s(I))> along the 'position' dimension or

  <J, j> is not iconically projectable to <body(s(J)), forehead(s(J))> along the 'position' dimension.
  i.e. failure if <area locus, point locus> is not iconically projectable to <body, forehead>

  If ≠ #, [[i-j-COMMUNICATE-BY-TELEPATHY]]$^{c, s}$(y)(x) = 1 iff x communicates by telepathy with y.


Broad locus J
Narrow
locus j

[Locus-internal Iconicity]

- [[JOHN i-ASK-QUESTIONS-k $Ø_k$]]$^{c, s}$ = #
  iff [[i-ASK-QUESTION-k]]$^{c, s}$(c_a)(John) = #,
  iff <K, k> is not iconically projectable to <body(c_a), chin(c_a)> along the 'body' dimension or <I, i> is not iconically projectable to <body(j), chin(j)> along the 'body' dimension.

  If [[JOHN i-ASK-QUESTIONS-k $Ø_k$]]$^{c, s}$ ≠ #, [[JOHN i-ASK-QUESTION-k $Ø_k$]]$^{c, s}$ = 1 iff [[i-ASK-QUESTION-k]]$^{c, s}$(c_a)(John) = 1, iff John asks questions to c_a.

Conclusion

- a. Indexes can play the role of formal indices.
  b. They are structured and localized indices

- Three cases in which **preservation of geometric properties of loci plays constrains interpretation:**

  Structural iconicity: loci are closed by relative complementation + assignment functions respect complements.

  Locus-external iconicity: high loci trigger presuppositions

  Locus-internal iconicity: loci are internally structured

- a. We have made **restricted** and **formal** use of iconicity.
  b. **Loci** can be ***both*** **variables and simplified pictures**.

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