Dependent indefinites – the view from sign language

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1  Overview

• In natural language, indefinites introduce individuals into the discourse context.

  (1) I read a book. (It was interesting.)
  (2) I read three books. (They were interesting.)

• In many languages, indefinites may be inflected to create a dependent indefinite.
  – Indicates that the value of the DP varies w.r.t. something else in the sentence or context.

  (3) Telugu (Balusu 2006)
    pilla-lu renDu-renDu kootu-lu-ni cuus-ee-ru.
    kids two-two monkey-Pl-Acc see-Past-3PPL
    ‘(The) kids saw two monkeys each.’

  (4) ASL
    BOYS IX-arc-a READ ONE-arc-a BOOK.
    ‘The boys read one book each.’

• Distributive meaning: two monkeys per kid; one book per boy

Questions for today

1. What is the relation between a dependent term and its licensor? (Anaphoric or indirect?)

2. Does the distributive meaning reside in the dependent indefinite itself, or is it parasitic on a (possibly covert) distributivity operator elsewhere in the sentence?

3. (How does a dependent indefinite ‘see outside’ the scope of a distributive operator?)
The point of view from sign language

• Dependent indefinites in ASL fit into a broader typology:
  – interpretation
  – licensing conditions
  – even morphological marking via reduplication

• Additionally, ASL pattern employs the use of space.
  1. Overt representation of the relation between a dependent indefinite and its licensor.
     * Anaphoric!
  2. Spatial marking of dependency also appears on the adjectives SAME and DIFFERENT.
     * Intrinsically distributive!

• Consequences for recent theories of dependent indefinites.

2 Visible dependency

• The meaning of dependent indefinites can be characterized by a variation condition:
  – the value taken by the dependent indefinite varies with the atoms of the plural licensor.

• The variation condition can be seen in the fact that collective readings become unavailable with dependent indefinites.

(5) a. ALL BOY LIFT ONE TABLE. ✓ collective ✓ distributive
    b. ALL BOY LIFT ONE-arc TABLE. * collective ✓ distributive

‘All the boys lifted a table.’

The use of space in ASL

• Singular individuals indexed at points in space. (Lillo-Martin and Klima 1990, i.a.)

• Plurals are indexed over areas of space.
A spatial representation of dependency:

- Dependent indefinites are obligatorily signed over the same area of space as their licensor.

(6) **EACH-a PROFESSOR SAID ONE-arc-a STUDENT WILL RECEIVE B.**
   ‘Each professor said that one student will receive a B.’

(7) ?? **EACH-a PROFESSOR SAID ONE-arc-b STUDENT WILL RECEIVE B.**
   ‘Each professor said that one student from each salient group will receive a B.’

Removing ambiguity in ASL

- Since the arc-motion agrees with licensor, can specify **what the indefinite is dependent on**.

- Consider a sentence with two potential licensors.

(8) **Hungarian** (p.c. Dániel Szeredi; four speakers)
   A fiúk két-két könyvet adtak a lányoknak.
   The boys two-two book give.3Pl the girls
   ‘The boys gave the girls two books each.’

- Judgement: ‘two-two’ can depend on either boys or girls.

  a. Distribution across the girls.
     ‘To Mary, from the boys’

  b. Distribution across the boys.
     ‘To the girls, from John.’

- With the use of space, ASL can disambiguate!

(9) **ALL-a BOY-a GAVE ALL-b GIRL-b ONE-arc-b BOOK.**
    ‘All the boys gave all the girls one book per girl.’

    - Reading (b), with distribution across the boys, is **not possible**.
Theoretical import

- **Debate in the literature:** what is the relation between a dependent term and its licensor?

- Two sides:

<table>
<thead>
<tr>
<th>Anaphoric link (like pronouns)</th>
<th>Indirect relation (like NPIs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brasoveanu &amp; Farkas 2011</td>
<td>Balusu 2006</td>
</tr>
<tr>
<td>Brasoveanu 2011 (<em>different</em>)</td>
<td>Henderson 2014</td>
</tr>
<tr>
<td>Barker 2007 (<em>same</em>)</td>
<td>Cable 2014</td>
</tr>
</tbody>
</table>

- **New conclusion:** the ASL data is overtly anaphoric.

3 A compositional puzzle: whence the distributive force?

A licensing puzzle

- A key property: **licensing**

  - In many languages, dependent indefinites are...

    - ...licensed by plurals,
    - ...licensed by distributive operators,
    - ...ungrammatical when all arguments are singular.

- This holds in some form in...

  - Kaqchikel (Henderson 2014), Hungarian (Farkas 1997), Romanian (Brasoveanu & Farkas 2011), Albanian (Rushiti 2015), Telugu (Balusu 2006), some dialects of English (Champollion 2015a), and ASL (this work).

Licensing examples

(10) **Kaqchikel Mayan** (Henderson 2014)

<table>
<thead>
<tr>
<th>a. Xeqatij ox-ox wäy.</th>
<th>‘We each ate three tortillas.’</th>
</tr>
</thead>
<tbody>
<tr>
<td>we-eat</td>
<td>three-three tortilla</td>
</tr>
<tr>
<td>b. Chikijujunal ri tijoxela’ xkiq’etej ju-jun tz’i’.</td>
<td>‘Each of the students hugged a dog.’</td>
</tr>
<tr>
<td>each</td>
<td>the students hugged one-one dog</td>
</tr>
<tr>
<td>c. * Xe’inchäp ox-ox wäy.</td>
<td>‘I took (groups of) three tortillas.’</td>
</tr>
<tr>
<td>I-handle</td>
<td>three-three tortilla</td>
</tr>
</tbody>
</table>

Desired reading: ‘I took (groups of) three tortillas.’
Telugu (Balusu 2006)

a. Pilla-lu renDu-renDu kootuluni cuuseeru kid-Pl two-two monkeys saw
   ‘(The) kids saw two monkeys each.’
   Two readings: ‘participant key’ and ‘temporal key.’

b. Prati pillavaaDu renDu-renDu kootuluni cuuseeDu
   Every kid two-two monkeys saw
   ‘Every kid saw two monkeys (each).’
   Two readings: ‘participant key’ and ‘temporal key.’

c. Raamu renDu-renDu kootuluni cuuseeDu
   Ram two-two monkeys saw
   ‘Ram saw two monkeys each.’
   Only ‘temporal key’ reading.

Albanian (Rushiti 2015)

a. Fëmijët kanë parë nga pesë mace.
   children-the have seen DIST five cats
   ‘The children have seen five cats each’

b. Në çdo dhomë kishte nga dy fotografi.
   in every room there-were DIST two photos
   ‘There were two (different) photos in each room’

c. * Në dhomë kishte nga dy fotografi.
   in room there-were DIST two photos
   Desired reading: ‘There were two (different) photos in the room.’

English

a. The boys saw two zebras each.

b. % Every job candidate was in the room for fifteen minutes each.

c. * Ariella saw two zebras each.

American Sign Language fits in perfectly:

ASL

a. BOYS IX-arc-a READ ONE-arc-a BOOK.
   ‘The boys read one book each.’

b. EACH-EACH-a PROFESSOR NOMINATE ONE-redup-a STUDENT.
   ‘Each professor nominated one student.’

b. * JOHN-a READ ONE-arc-a BOOK.
   Desired reading: ‘John read one book.’
A compositional puzzle

- Quantifiers like English *every* distribute down to atomic parts.

(15) **English**

- a. The boys gathered.
- b. * Every boy gathered.

(16) **ASL**

- a. MY FRIENDS, IX-arc-a GATHER.
- b. * EACH STUDENT MY CLASS GATHER.
- c. * JOHN GATHER.

A compositional puzzle

- Dependent indefinites under distributive operators seem to be puzzlingly redundant (e.g. Balusu 2006, Oh 2005).
  - With a plural licensor, they seem to contribute distributive force themselves.
  - Under distributive operators, they appear to be semantically vacuous.

- If there are cases in which they are semantically vacuous, then why can’t they appear innocently under singular subjects?

Two possible directions

**Option 1:** Treat licensing by distributives as the ‘base case.’

(17) The boys **DIST** [saw two-two zebras].

**Option 2:** Treat licensing by plurals as the ‘base case.’

(18) \[[two-two books]\] = Given a licensor \(X\),
 prerequisites that \(X\) is nonatomic,
 \(\forall\) atomic parts \(x\) of \(X\), there are two books associated with \(x\)
• For distributive operators:
  – The dependent indefinite is able to ‘escape’ from the distributive scope, to get access to a higher plurality.
  – This plurality is made available by the compositional system.

A problem for Option 1
(Option 1 = plural licensors require a covert distributivity operator)

• Distributive operators generally assumed to appear over VP.

• However, dependent indefinites may be conjoined with plain indefinites that are interpreted cumulatively.

(19) Hungarian (p.c. Dániel Szeredi)
A diákok két előételt és egy-egy főételt rendeltek.
The students two appetizers and one-one main-dish ordered.
‘The students ordered two appetizers in total, and as many main dishes as students’

(20) Tamil (Chennai dialect) (p.c. Anushree Sengupta)
Mānavarkkal thankalai kaga oru-oru appetizer o irenDu desserts share-panna order pannagu.
students themselves for one-one appetizer and two desserts share-do order did
‘The students ordered one appetizer each for themselves and two desserts to share.’

• If the dependent indefinite scopes under a covert distributive operator, the plain indefinite must do so, too, incorrectly entailing twice as many appetizers as students.

Support for Option 2
(Option 2 = dependent indefinites are themselves distributive)

• Observation: English same shows the same distributional pattern as dependent indefinites

(21) English same (on internal reading):
  a. The students gave the same answer.
  b. Each student gave the same answer.
  c. * Edith gave the same answer.

• Observation: in ASL, dependent indefinites, SAME, and DIFFERENT are morphologically unified.
SAME/DIFFERENT show the same pattern of spatial agreement.

(22) BOY THEY-arc-a READ {ONE/SAME/DIFFERENT}-arc-a BOOK.
    ‘The boys read {one book each/the same book/different books}.’

Like for dependent indefinites, ASL may remove ambiguity with multiple licensors.

(23) Every boy gave every girl the same book.
    a. Reading 1: unimaginative boys
    b. Reading 2: unlucky girls

(24) Every boy gave every girl a different book.

(Bumford and Barker 2013)

(25) BOYS IX-arc-a EACH GIVE-alt-b ALL-b GIRL-b SAME-arc-b BOOK.

    – Only ‘Reading 1’: same with respect to the girls.

Theoretical conclusion: Dependent indefinites and the adjectives same and different should be treated in fundamentally the same way.

• Consider the meaning of same.

(26) Each student lifted the same table.

• A different table-lifting for each boy; in this sense, variation with respect to the licensor.

• But of course, this is not all; same compares the tables lifted by each boy.

    – For each pair of boys, they lifted the same table.

• This meaning is inherently quantificational.

Thus...

• Same must be given inherently quantificational meaning.

• Morphological parallels in ASL suggest that dependent indefinites should be treated analogously.
The proposal in a nutshell

- Dependent indefinites introduce a plurality into a discourse.
- Two components of meaning:
  - **Presupposition**: the plurality can be divided into subpluralities that vary with respect to the atoms of a licensor.
  - **At-issue**: each of these subpluralities is of a given cardinality.
- Licensing by *each* is achieved by QR of the dependent indefinite, letting it scope outside the distributive operator.
  - Critically, the framework of Plural Compositional DRT allows the semantics to make reference to the functional dependency even outside of the distributive scope.

4 Introducing Plural Compositional DRT

Background: dynamic semantics

- **Dynamic semantics**: discourse referents represented as the values of an assignment function, $g$ (essentially, a list).

\[
g = \begin{array}{c}
\text{john} \\
\text{mary} \\
\end{array} \ldots
\]  
(Groenendijk & Stokhof 1991)

- Passed through discourse: the output context of one sentence is the input context of the next.
- Indefinites add new individuals to the list. Pronouns retrieve elements from the list

Standard dynamic semantics, an example

(27)  (a) $A^x$ boy entered. (b) $A^y$ girl exited. (c) She$_y$ was angry.

\[
\text{(a)} \quad \text{(b)} \quad \text{(c)}
\]

\[
\text{(a)} \quad \text{(b)} \quad \text{(c)}
\]

\[
\text{(a)} \quad \text{(b)} \quad \text{(c)}
\]
Universals in dynamic semantics

Standard dynamic semantics:

• Universals *every* and *each* taken to be ‘externally static.’
  
  – Indefinites in their scope are not available to later discourse.

• At a first approximation, this seems to be correct:

  (28) * Every\(^x\) farmer owns a\(^y\) donkey. It\(^y\) kicked me in the shin.

• But...

Quantificational subordination (Heim 1990, Brasoveanu 2006)

(29) Two\(^x\) farmers each own a\(^y\) donkey.
    Neither of them\(^x\) treat it\(^y\) very well.

• The pronoun *it* is anaphoric to the indefinite *a donkey*, yet it doesn’t refer to a particular donkey or to the set of all donkeys.

  – It picks out the same correspondence that was introduced by the first sentence.

Dynamic Plural Logic; Plural Compositional DRT (van den Berg 1996, Nouwen 2003, Brasoveanu 2006)

• We need to be able to ‘re-open’ the scope of a universal.

• Instead of just *checking* that there is one donkey per farmer, the system must *store* this representation.

• Instead of passing assignment functions through the discourse, it passes *sets* of assignment functions.

  – \( G = \begin{array}{cc}
  x & y \\
  \text{christopher} & \text{eeyore} \\
  \text{jones} & \text{benjamin} \\
  \ldots
  \end{array} \)

• \( G, H \) are variables over these ‘information states’ (i.e. tables).

(30) Two\(^x\) farmers each own a\(^y\) donkey.
    Neither of them\(^x\) treat it\(^y\) very well.
System summary

- I adopt the Plural Compositional DRT of Brasoveanu 2006; full definitions in Appendix A.

Informally, ...

- \([x]\) introduces individuals across \(G\) at index \(x\).
- Predicates test that a certain property holds for the values in each \(g \in G\).
- Numerals are tests of the cardinality of the set of distinct values of some index \(x\) in \(G\).

An example

(31) a. Two\(^x\) girls saw three\(^y\) dogs.

b. \([x] \land \text{GIRLS}(x) \land x = 2 \land [y] \land \text{DOGS}(y) \land y = 3 \land \text{SAW}(x, y)\)
The distributive operator

- The distributive operator $\delta_x(\varphi)$ divides up a table with respect to the values of $x$, evaluates $\varphi$ on each of these substates in parallel, then gathers up the resulting states.

(32)  

a. ... each read a book.

b. $\delta_x([y] \land \text{BOOK}(y) \land \text{READ}(y, x))$

From earlier: The proposal in a nutshell

- Dependent indefinites introduce a plurality into a discourse.

- Two components of meaning:
  
  - **Presupposition**: the plurality can be divided into subpluralities that vary with respect to the atoms of a licensor.
  
  - **At-issue**: each of these subpluralities is of a given cardinality.

- We can now translate these statements into PCDRT.
Substates based on the licensor

• First, an information state is divided up with respect to the values of the licensor. \( \{G|_{x=d(y)} \} \) is a set of sets.

\[
(33) \quad G|_{x=d(y)} := \{ g(y) | g \in G \land g(x) = d \}
\]

• Below, \( x \) corresponds to the licensor; \( y \) corresponds to the dependent indefinite.

\[
(34) \quad a. \; G = x \begin{array}{c}
        \hline
        a & e \\
        a & f \\
        b & g \\
        b & h \\
        c & i \\
        c & j \\
        \end{array}
\]

b. \( \{G|_{x=d(y)} \} = \{ \{e, f\}, \{g, h\}, \{i, j\} \} \)

Presupposition of dependency

• **Presupposition**: the plurality can be divided into subpluralities that vary with respect to the atoms of a licensor.

\[
(35) \quad \text{outside}(y/x) > 1 := \lambda GH.G = H \land |\{G|_{x=d(y)} \}| > 1
\]

• Equivalent to Nouwen’s (2003) definition of dependency.

Cardinality assertion

• **At-issue**: each of these subpluralities is of a given cardinality.

\[
(36) \quad \text{inside}(y/x) = n := \lambda GH.G = H \land \forall T \in \{G|_{x=d(y)} \}.|T| = n
\]

Lexical definition of a dependent indefinite

\[
(37) \quad \text{two-two}^y \equiv \lambda NP. [y] \land N(y) \land P(y) \land \text{outside}(y/x) > 1 \land \text{inside}(y/x) = 2
\]

• Note that the two cardinality checkers are evaluated after the two predicates are introduced.
  
  – This allows the cardinality checkers to refer to an index that is introduced by an argument of the dependent indefinite.
  
  – This is the reflection in my analysis of Henderson’s (2014) insight that the plurality condition of a dependent indefinite is somehow ‘postsuppositional.’
Quantifier raising

- I assume that quantifiers can move by Quantifier Raising (QR).

(38) a. \[ S \quad \Rightarrow \quad b. \quad S \]

\[ ... \quad DP \quad ... \]

\[ DP \quad \Lambda z \quad S \]

\[ ... \quad t_z \quad ... \]

Example 1

(39) a. Three\(^x\) students saw two-two\(^y\) zebras.

b. \[ [x] \land \text{STUDENTS}(x) \land [y] \land \text{ZEBRAS}(y) \land \text{SAW}(y)(x) \land \text{inside}(x) = 3 \land \text{outside}(y/x) > 1 \land \text{inside}(y/x) = 2 \]

(40)

| student\(_1\) | zebra\(_1\) | student\(_1\) | zebra\(_2\) |
| student\(_1\) | zebra\(_2\) | student\(_1\) | zebra\(_1\) |
| student\(_2\) | zebra\(_1\) | student\(_2\) | zebra\(_3\) |
| student\(_2\) | zebra\(_2\) | student\(_2\) | zebra\(_4\) |
| student\(_3\) | zebra\(_1\) | student\(_3\) | zebra\(_3\) |
| student\(_3\) | zebra\(_3\) | student\(_3\) | zebra\(_6\) |

Example 2 (unsuccessful derivation)

(41) a. Each\(^x\) student saw two-two\(^y\) zebras.

b. \[ \text{max}_x(\text{STUDENT}(x)) \land \delta_x([y] \land \text{ZEBRAS}(y) \land \text{SAW}(y)(x) \land \text{outside}(y/x) > 1 \land \text{inside}(y/x) = 2) \]

(42)

\[ S \]

\[ \lambda P, \text{max}_x(\text{STUDENT}(x)) \land \delta_x(P(x)) \land \lambda l, [y] \land \text{ZEBRAS}(y) \land \text{SAW}(y)(l) \land \text{outside}(y/x) > 1 \land \text{inside}(y/x) = 2 \]

\[ \lambda z \quad \text{each} \quad \text{student} \]

\[ \lambda z \]

\[ \text{two-two}\(^y\) \quad \text{zebras} \]

\[ \lambda w \quad \text{SAW}(w)(z) \]

\[ t_z \quad \text{saw} \]

\[ t_w \]
• Observe: the variation condition—i.e., the condition that outside\((y/x) > 1\)—appears inside the distributive scope of \(\delta_x\).
  
  – It is evaluated with respect to a substate of \(G\) where \(x\) is restricted to a single value.
  – The variation condition cannot be met, and the derivation fails.

**Example 2 (successful derivation)**

• The dependent indefinite takes scope outside the distributive operator.

(43)  

a. Each\(^x\) student saw two-two\(^y\) zebras.

\[\lambda \forall y. \max_x (\text{STUDENT}(x)) \land \delta_x (\text{SAW}(y)(x)) \land \text{outside}(y/x) > 1 \land \text{inside}(y/x) = 2\]

b. \([y] \land \text{ZEBRAS}(y) \land \max_x (\text{STUDENT}(x)) \land \delta_x (\text{SAW}(y)(x)) \land \text{outside}(y/x) > 1 \land \text{inside}(y/x) = 2\]

(44)

\[\lambda P. \forall y. \max_x (\text{STUDENT}(x)) \land \delta_x (\text{SAW}(k)(x)) \land \text{outside}(y/x) > 1 \land \text{inside}(y/x) = 2\]

• The variation condition ‘outside\((y/x) > 1\)’ appears after distributive scope has closed, giving it access to the full set of values of \(x\) and \(y\).

5 **Theoretical payoff: how to take scope**

• The essential insight for licensing by *each* comes from Henderson 2014.

  1. Dynamically tracking dependency relations with PCDRT.
  2. Evaluating the variation condition after the distributive scope has closed.

• However, on his analysis, dependent indefinites have the same at-issue content as plain indefinites. (They’re not distributive.)

• For Henderson 2014, result is a kind of ‘split-scope’:

  – At-issue content must scope below the distributive operator.
  – The variation condition must scope above it.
Postsuppositions?

• Henderson: the variation condition is a **postsupposition**. (Brasoveanu 2012)

• Formally, postsuppositions are a special *kind* of meaning.
  (By analogy with presuppositions.)
  – Instead of being evaluated *in situ*, they are passed through the dynamic system until a later operator triggers their evaluation.

On the other hand:

• The current analysis, with a distributive at-issue component, does not require separation of the two components of meaning: standard QR works, with no need for postsuppositions.

• *Further prediction of ‘standard scope-taking’: sensitivity to scope islands*
  – Dependent indefinites are licensed by distributive operators by scoping over them.
  – Thus: ungrammaticality when an island boundary (indicated below with ⟨·⟩) intervenes between a dependent indefinite and its potential licensor

  **Hungarian** (p.c. Mártita Abrusán, two speakers)

(45) Minden professzor két-két diákról mondta, hogy meglepő ha ⟨diplomát szereznének⟩.  
  every professor two-two students-of said that surprised if diploma receive  
  ‘Every professor said of two students (each) that he would be surprised if they graduated.’

(46) * Minden professzor azt mondta, hogy meglepő, ha ⟨két-két diá diákról diplomát szerezne⟩.  
  every professor DEM said that surprised if two-two student diploma receive  
  ‘Every professor said that he would be surprised if two students (each) graduated.’

• To my knowledge, not predicted by any other theory.

6 Summary

• I addressed the following architectural questions:

    1. Do dependent indefinites have an anaphoric component?
    2. Are dependent indefinites quantificational?

• The latter of these turns out to be connected to a third architectural question:

    3. Do dependent indefinites see outside of distributive operators via postsuppositions or standard scope?

• *My answers were:*
  Dependent indefinites have an anaphoric component. They are quantificational. They are subject to standard scope.
Appendix A: Full fragment

<table>
<thead>
<tr>
<th>Type</th>
<th>Variables</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>truth value</td>
<td>true, false</td>
<td></td>
</tr>
<tr>
<td>index</td>
<td>i, j, k, l w, x, y, z</td>
<td></td>
</tr>
<tr>
<td>entity</td>
<td>d, e      john, mary</td>
<td></td>
</tr>
<tr>
<td>integers</td>
<td>n, m      1, 2</td>
<td></td>
</tr>
<tr>
<td>predicate</td>
<td>P, Q, N   LEFT, ZEBRA</td>
<td></td>
</tr>
<tr>
<td>assignment function</td>
<td>g, h      al eve</td>
<td></td>
</tr>
<tr>
<td>information state assign. fn. → truth value</td>
<td>G, H x y al eve</td>
<td></td>
</tr>
</tbody>
</table>

| proposition               | inf. state → inf. state → truth value | ϕ, ψ |

(47) \( G(i) := \{g(i)|g \in G\} \)
(48) \( G|_{i=d} := \{g|g \in G \& g(i) = d\} \)
(49) \( g[i]h \iff \) for any index \( j, j \neq i, \) then \( g(j) = h(j) \)
(50) \( G[i]H \iff \) for all \( g \in G, \) there is a \( h \in H \) such that \( g[i]h, \) and for all \( h \in H, \) there is a \( g \in G \) such that \( g[i]h \)
(51) \([j] := \lambda GH.G[j]H\)
(52) \( \varphi \land \psi := \lambda GH.\exists K.\varphi(G)(K) \land \psi(K)(H)\)
(53) For any \( n \)-place predicate \( P \) with classical logic denotation \( I(P), \)
\( P(i_1, \ldots, i_n) := \lambda GH.G = H \& \forall g \in G.\langle g(i_1), \ldots, g(i_n)\rangle \in I(P)\)
(54) \( \delta_i(\varphi) := \lambda GH.G(i) = H(i) \& \forall d \in G(i).\varphi(G|_{i=d})(H|_{i=d})\)
(55) \( \text{max}_i(\varphi) := \lambda GH.([x] \land \varphi)(G)(H) \land \exists H'.H(x) \subset H'(x) \land ([x] \land \varphi)(G')(H')\)
(56) \( \text{inside}(j) = n := \lambda GH.G = H \& |H(j)| = n\)
(57) \( \text{inside}(j/i) = n := \lambda GH.G = H \& \forall T \in \{H|_{i=d(j)}\}.|T| = n\)
(58) \( \text{outside}(j/i) > 1 := \lambda GH.G = H \& |\{H|_{i=d(j)}\}| > 1\)
(59) a. \([\text{students}] = \lambda j.\text{STUDENTS}(j)\)
   b. \([\text{zebras}] = \lambda j.\text{ZEBRAS}(j)\)
   c. \([\text{left}] = \lambda j.\text{LEFT}(j)\)
   d. \([\text{saw}] = \lambda i j.\text{SAW}(i)(j)\)
(60) \([\text{three}] = \lambda NP.\text{P}(j) \land N(j) \land P(j) \land \text{inside}(j) = 3\)
(61) \([\text{two-two}] = \lambda NP.\text{P}(j) \land N(j) \land P(j) \land \text{outside}(j/i) > 1 \land \text{inside}(j/i) = 2\)
(62) \([\text{each}] = \lambda NP.\text{max}_i(\text{N}(i)) \land \delta_i(P(i))\)
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References


