Dependent indefinites – the view from sign language

Jeremy Kuhn • Institut Jean Nicod, CNRS, Ecole Normale Supérieure

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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

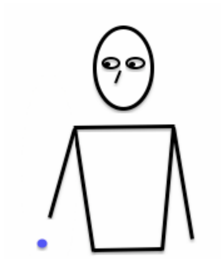
- The meaning of dependent indefinites can be characterized by a **variation condition:**
  - the value taken by the dependent indefinite varies with the atoms of the plural licensor.

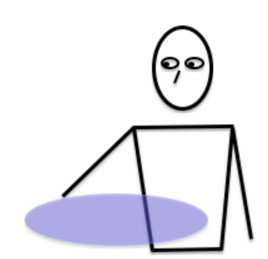
- The variation condition can be seen in the fact that collective readings become unavailable with dependent indefinites.

(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.


singular locus


plural locus

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)

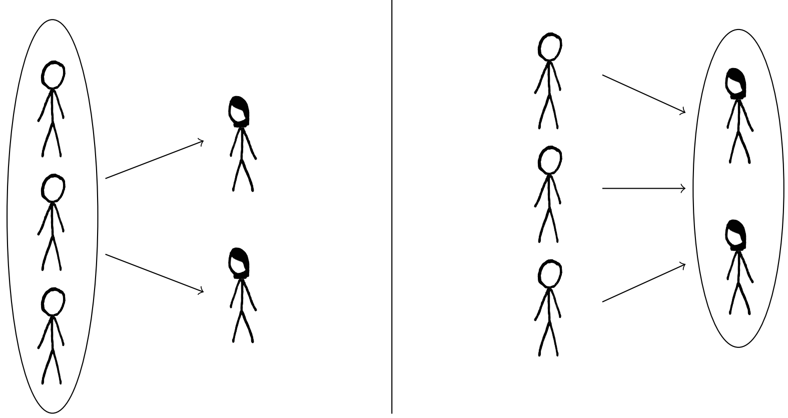
A	fiúk	két-két	könyvet	adtak	a	lányoknak.
The	boys	two-two	book	give.3Pl	the	girls

‘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:

Anaphoric link (like pronouns)	**Indirect relation** (like NPIs)
Brasoveanu & Farkas 2011	Balusu 2006
Brasoveanu 2011 (*different*)	Henderson 2014
Barker 2007 (*same*)	Cable 2014

- **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)

a. Xeqatij <u>ox-ox</u> wäy.
we-eat three-three tortilla
'We each ate three tortillas.'

b. Chikijujunal ri tijoxela' xkiq'etej <u>ju-jun</u> tz'i'.
each the students hugged one-one dog
'Each of the students hugged a dog.'

c. * Xe'inchäp <u>ox-ox</u> wäy.
I-handle three-three tortilla
Desired reading: 'I took (groups of) three tortillas.'

(11) **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.

(12) **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.'

(13) **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:

(14) **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.'

c. * 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.
  c. * Edith gathered.

(16) **ASL**
  a. MY FRIENDS, IX-arc-a GATHER.
  'My friends gathered.'
  b. * EACH STUDENT MY CLASS GATHER.
  'Each student in my class gathered.'
  c. * JOHN GATHER.
  'John gathered.'

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.'
(Brasoveanu and Farkas 2011, Henderson 2014)

- The at-issue meaning of a dependent indefinite is equivalent to that of a plain indefinite.
- A syntactic or semantic constraint (e.g. 'distributive concord') requires the indefinite to scope under a distributive operator.
- Licensing by plurals arises via a covert distributivity operator.

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

Option 2: Treat licensing by plurals as the 'base case.' (Balusu 2006, Cable 2014)

- The at-issue meaning of a dependent indefinite is itself quantificational/distributive.

(18) $[\![\text{two-two books}]\!] =$ Given a licensor X,
presupposing 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)

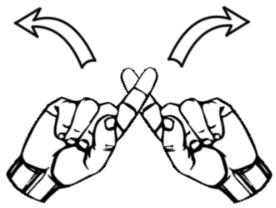
- **Observation:** English *same* shows the same distributional pattern as dependent indefinites

(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

- 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 Compositonal DRT

Background: dynamic semantics

- **Dynamic semantics:** discourse referents represented as the values of an assignment function, g (essentially, a list).
  - (Groenendijk & Stokhof 1991)

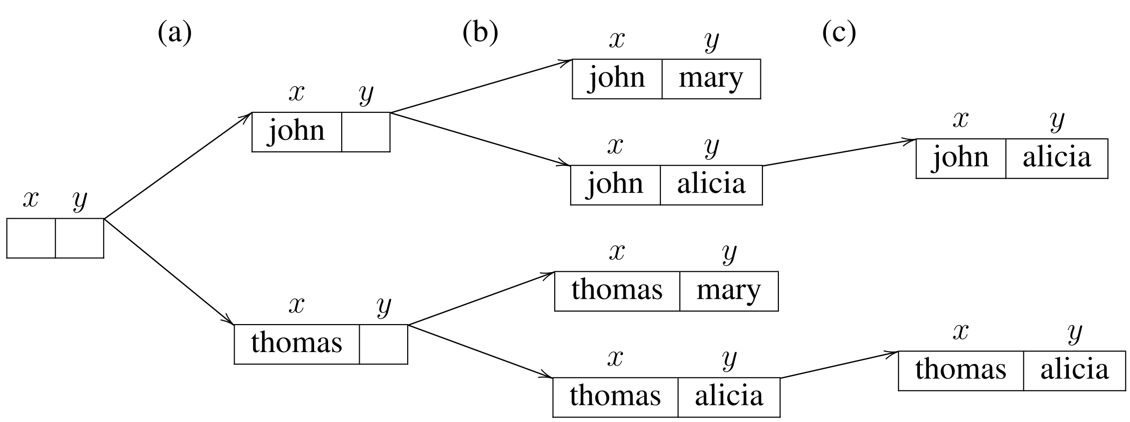
    $g =$

x	y	z	
john	mary		$\cdots$

- 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.



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)

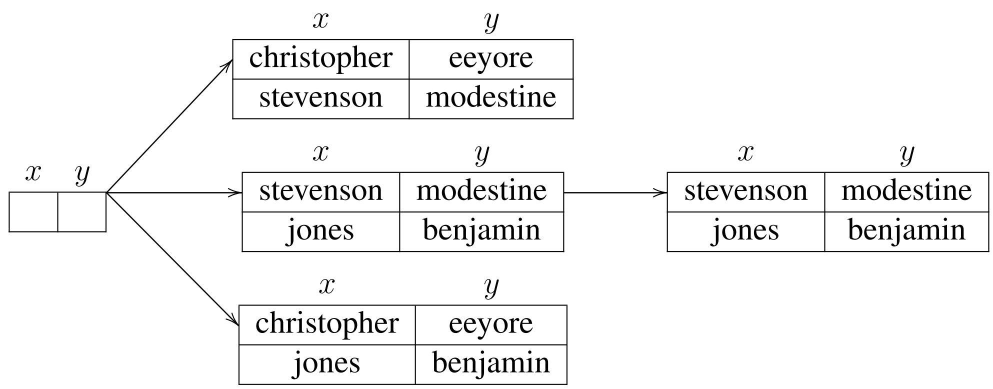
- We need to be able to 're-open' the scope of a universal.
- Instead of just *checking* that there is one donkey per farmer, the system must *store* this representation.
- Instead of passing assignment functions through the discourse, it passes *sets* of assignment functions.
  - $G =$

x	y
christopher	eeyore
jones	benjamin

. . .

- 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.

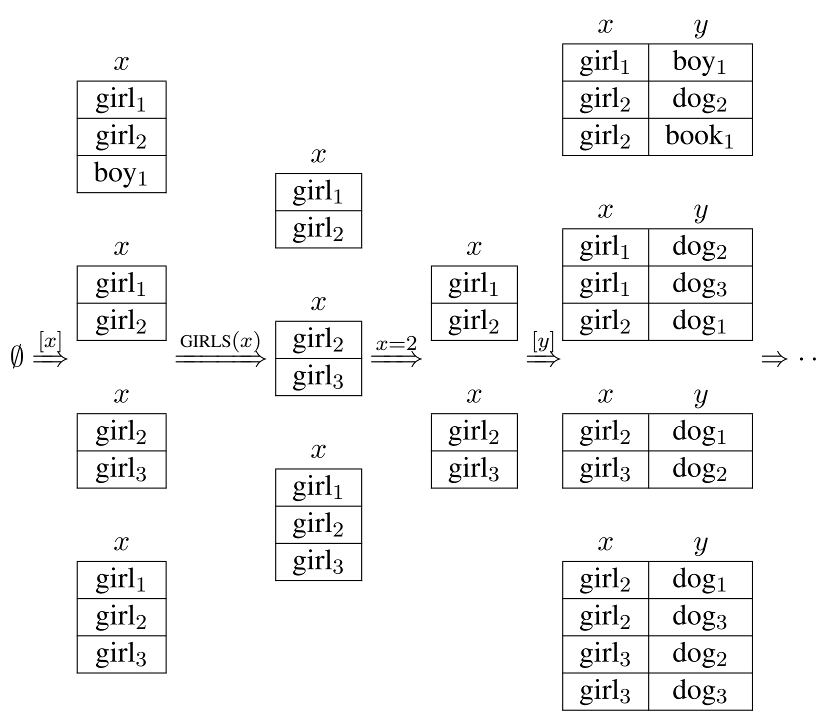
Informally, ...

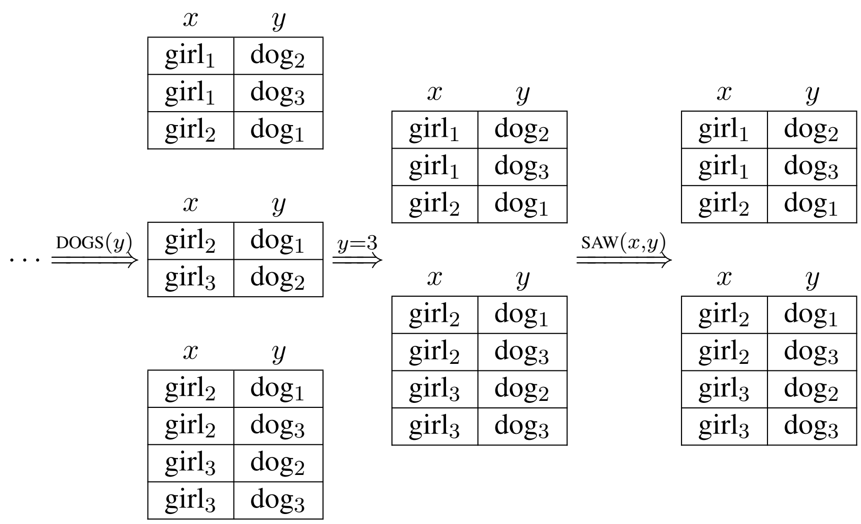
- $[x]$ introduces individuals across G at index x.
- Predicates test that a certain property holds for the values in each $g \in G$.
- Numerals are tests of the cardinality of the set of distinct values of some index x in G.

An example

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

b. $[x] \wedge \text{GIRLS}(x) \;\wedge\; x = 2 \;\wedge\; [y] \wedge \text{DOGS}(y) \;\wedge\; y = 3 \wedge \text{SAW}(x, y)$



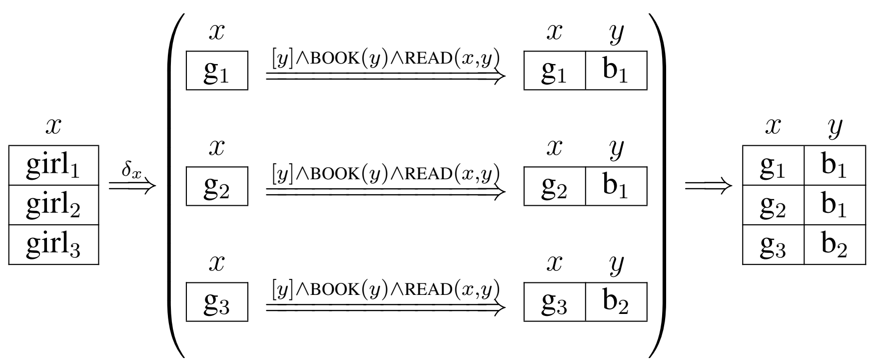


The distributive operator

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

(32) a. ... each read a book.

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



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) $G|_{x=d}(y) := \{g(y)|g \in G \ \&\ g(x) = d\}$

- Below, x corresponds to the licensor; y corresponds to the dependent indefinite.

(34) a. $G =$

x	y
a	e
a	f
b	g
b	h
c	i
c	j

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

Presupposition of dependency

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

(35) $\textbf{outside}(y/x) > 1 \quad := \quad \lambda GH.G = H \quad \& \quad |\{G|_{x=d}(y)\}| > 1$

- Equivalent to Nouwen's (2003) definition of dependency.

Cardinality assertion

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

(36) $\textbf{inside}(y/x) = n \quad := \quad \lambda GH.G = H \quad \& \quad \forall T \in \{G|_{x=d}(y)\}.|T| = n$

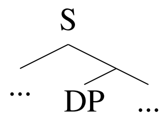
Lexical definition of a dependent indefinite

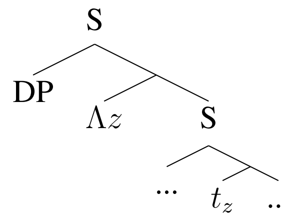
(37) $[\![\text{two-two}^y_x]\!] = \lambda NP.[y] \ \wedge\ N(y) \ \wedge\ P(y) \ \wedge\ \textbf{outside}(y/x) > 1 \ \wedge\ \textbf{inside}(y/x) = 2$

- 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. 

⇒ b. 

Example 1

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

b. $[x] \wedge \textsc{students}(x) \wedge [y] \wedge \textsc{zebras}(y) \wedge \textsc{saw}(y)(x) \wedge$ $\textbf{inside}(x) = 3 \wedge \textbf{outside}(y/x) > 1 \wedge \textbf{inside}(y/x) = 2$

(40)

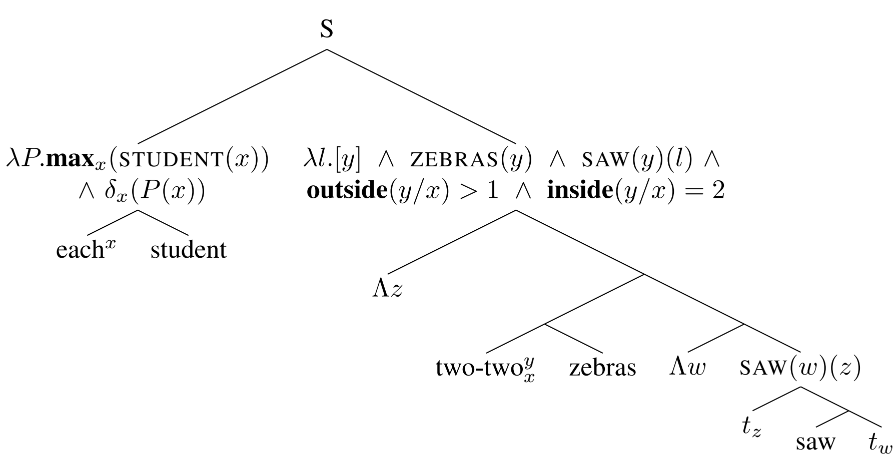
student_1	zebra_1	student_1	zebra_1
student_1	zebra_2	student_1	zebra_2
student_2	zebra_1	student_2	zebra_3
student_2	zebra_2	student_2	zebra_4
student_3	zebra_1	student_3	zebra_5
student_3	zebra_3	student_3	zebra_6

...

Example 2 (unsuccessful derivation)

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

b. $\textbf{max}_x(\textsc{student}(x)) \wedge$
$\delta_x([y] \wedge \textsc{zebras}(y) \wedge \textsc{saw}(y)(x) \wedge$
$\textbf{outside}(y/x) > 1 \wedge \textbf{inside}(y/x) = 2)$

(42) 

- Observe: the variation condition—i.e., the condition that **outside**$(y/x) > 1$—appears inside the distributive scope of δ_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.

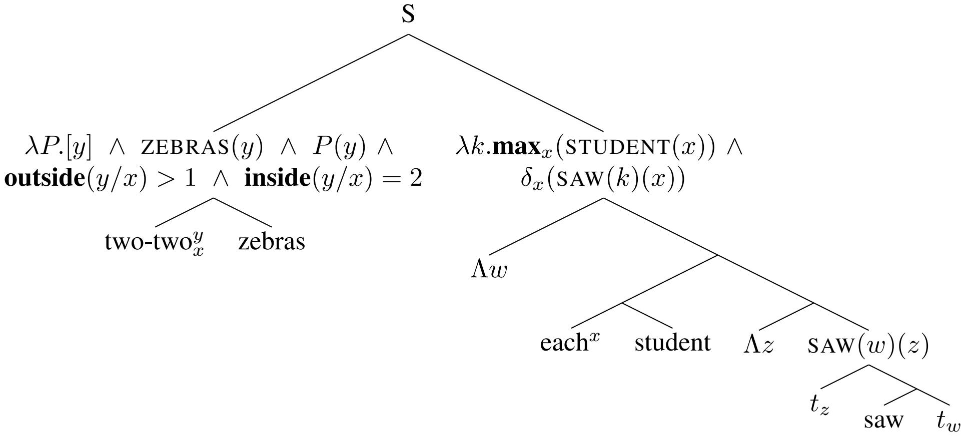
Example 2 (successful derivation)

- The dependent indefinite takes scope outside the distributive operator.

(43) a. Each^x student saw two-two^y_x zebras.

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

(44)



- 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. Márta Abrusán, two speakers)

(45) Minden professzor két-két diákról mondta, hogy meglepné 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 meglepné, ha ⟨két-két diák 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

Type		Variables	Example
truth value			true, false
index		i, j, k, l	w, x, y, z
entity		d, e	john, mary
integers		n, m	1,2
predicate	index $\rightarrow$ proposition	P, Q, N	LEFT, ZEBRA
assignment function	index $\rightarrow$ entity	g, h	$\begin{array}{cc} x & y \\ \hline \multicolumn{1}{\|c\|}{\text{al}} & \multicolumn{1}{c\|}{\text{eve}} \\ \hline \end{array}$
information state	assign. fn. $\rightarrow$ truth value	G, H	$\begin{array}{cc} x & y \\ \hline \multicolumn{1}{\|c\|}{\text{al}} & \multicolumn{1}{c\|}{\text{eve}} \\ \hline \multicolumn{1}{\|c\|}{\text{ed}} & \multicolumn{1}{c\|}{\text{ann}} \\ \hline \end{array}$
proposition	inf. state $\rightarrow$ inf. state $\rightarrow$ truth value	φ, ψ	

(47) $G(i) \quad := \quad \{g(i) | g \in G\}$

(48) $G|_{i=d} \quad := \quad \{g | g \in G \ \& \ g(i) = d\}$

(49) $g[i]h \quad \Leftrightarrow$ for any index j, if $j \neq i$, then $g(j) = h(j)$

(50) $G[i]H \quad \Leftrightarrow$ 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) $[j] \quad := \quad \lambda GH.G[j]H$

(52) $\varphi \wedge \psi \quad := \quad \lambda GH.\exists K.\varphi(G)(K) \ \& \ \psi(K)(H)$

(53) For any n-place predicate P with classical logic denotation $I(P)$,
$P(i_1, ..., i_n) \quad := \quad \lambda GH.G = H \ \& \ \forall g \in G.\langle g(i_1), ..., g(i_n)\rangle \in I(P)$

(54) $\delta_i(\varphi) \quad := \quad \lambda GH.G(i) = H(i) \ \& \ \forall d \in G(i).\varphi(G|_{i=d})(H|_{i=d})$

(55) $\mathbf{max}_i(\varphi) \quad := \quad \lambda GH.([x] \ \wedge \ \varphi)(G)(H) \ \& \ \neg\exists H'.H(x) \subset H'(x) \ \& \ ([x] \ \wedge \ \varphi)(G)(H')$

(56) $\mathbf{inside}(j) = n \quad := \quad \lambda GH.G = H \ \& \ |H(j)| = n$

(57) $\mathbf{inside}(j/i) = n \quad := \quad \lambda GH.G = H \ \& \ \forall T \in \{H|_{i=d}(j)\}.|T| = n$

(58) $\mathbf{outside}(j/i) > 1 \quad := \quad \lambda GH.G = H \ \& \ |\{H|_{i=d}(j)\}| > 1$

(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. $[\![\text{saw}]\!] = \lambda ij.\text{SAW}(i)(j)$

(60) $[\![\text{three}^j]\!] = \lambda NP.[j] \ \wedge \ N(j) \ \wedge \ P(j) \ \wedge \ \mathbf{inside}(j) = 3$

(61) $[\![\text{two-two}_i^j]\!] = \lambda NP.[j] \ \wedge \ N(j) \ \wedge \ P(j) \ \wedge \ \mathbf{outside}(j/i) > 1 \ \wedge \ \mathbf{inside}(j/i) = 2$

(62) $[\![\text{each}^i]\!] = \lambda NP.\mathbf{max}_i(N(i)) \ \wedge \ \delta_i(P(i))$

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