Dependent Indefinites within a Typology of Specificity

Adrian Brasoveanu, Donka F. Farkas · UC Santa Cruz · abrsvn,farkas@ucsc.edu

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1 Introduction

Aims

- typology of specificity with the aim of separating three types of Ds:
  - neutral (ordinary indefinite article)
  - specifiers (definite, demonstrative, *a certain*)
  - anti-specifiers (*some*, *vreun*, dependent indefinite)
- discuss a special type of anti-specifiers: dependent indefinites

2 Towards a typology of specificity

Some questions:

- What are the main paths one can carve within the jungle of specificity marking Ds?
- What, if any, is the common denominator underlying specificity distinctions?
- What expectations should we have concerning the type of information encoded in a D?
- How do scopal restrictions interact with specificity markings?

Some assumptions:

- (in)definite Ds: $<< e, t >, e >$-type functions from the set denoted by their sister (their *domain*) to an element of that set; introduce a variable (dref) and constrain its value to be an element of their domain
- basic distinction: neutral / non-neutral determiners
  - non-neutral determiners: place further semantic/pragmatic constraints on the variable
  - neutral determiners: don't add anything else

A cross-linguistic positive prediction:

- Ds may impose only semantically/pragmatically 'coherent' constraints (e.g., NPIs)

A cross-linguistic negative prediction:

- we do not expect Ds that encode *purely* structural restrictions[1]

Impossible restriction:

- variable (DP) must occur within the Nuclear Scope/Restrictor of some operator/quantifier or other (doesn't matter which)

A hypothesis:
There is a common restriction underlying the family of specificity distinctions, namely:

- specificity/non-specificity involves *regulating witness choice* by *requiring stability/variation in values.*

Within specificity encoding Ds, the major distinction is between:

- *Family of specifiers*: Ds that have the semantics of ordinary indefinites + a constraint that leads to relative *stability* of reference
- *Family of anti-specifiers*: Ds that have the semantics of ordinary indefinites + a constraint that leads to relative *variability* of reference

(1) *Specifiers*: definites, demonstratives, *a certain*, *ein gewiss/bestimmt*, *this*-indefinites, partitives

(2) *Anti-specifiers*: *some or other*, *algún*, FC determiners, *vreun*, *eyze*, negative indefinites, dependent indefinites

[1] Negative concord items come to mind as being sensitive to syntactic considerations but not even in their case, we suspect, are the relevant constraints purely syntactic.

(See Prince 1981, Farkas 1997b, Farkas 2002, JayezTovena 2002, JayezTovena 2006, Kagan 2007, Ionin 2006, Ebert & Ebert & Hinterwimmer to appear, Alonso-Ovalle & Menendez-Benito 2010, Kadmon 1990, Roberts 2003, von Heusinger 2000)

Specifier/anti-specifier dichotomy: not exhaustive but useful in leading to relevant set of questions:

- For *specifiers*: What variation do they tolerate? What can they have narrow scope relative to?
- For *anti-specifiers*: What type of variation do they require? What, if anything, do they have to be in the scope of?

Details of the answers depend on:

(i) nature of constraint D contributes

(ii) general assumptions about how variation of values for a variable can enter the picture

What is responsible for the heterogeneous nature of specificity distinctions?

(a) heterogenous nature of parameters of variation/stability

(b) heterogeneous nature of types of constraints Ds may impose

Basic notion:

- (quantificational) alternative: value of x under assignment g at world w

Stability/variation (specificity/non-specificity) of reference:

- same/different value for x relative to relevant set of alternatives where g and w vary

Two types of alternatives:

- *external*: the set of contexts (in the Tarskian / Montagovian sense) relative to which an expression e is true
  - set $\mathcal{G}$ such that e is true relative to each $g \in \mathcal{G}$ (we omit the model $\mathfrak{M}$ and the world of evaluation w)
  - $\forall g \in \mathcal{G}$, $[\![\text{A}^x \text{ student left}]\!]^g = 1$
- *internal*: assignment function (or set thereof) introduced by virtue of interpreting an expression e
  - the assignment h introduced by interpreting A^x *student left* relative to g
  - $[\![\text{A}^x \text{ student left.}]\!]^g = 1$ iff there is an h such that:
    - · h differs from g at most with respect to the value of x ($h[x]g$ for short)
    - · $h(x) \in [\![\textsc{student}]\!]^h$
    - · $h(x) \in [\![\textsc{leave}]\!]^h$

Variation within internal alternatives: some source within e (such as a quantifier or other operator) introduces a set of alternatives relative to g.

(3) Every^x student read a^y book.

y is evaluated relative to a set of internal alternatives H introduced by *every* that vary wrt values for x (as many internal alternatives as students).

Variation/stability requirements may target internal or external alternatives:

(a) External variation requirement: *some N or other*: x must have different values across different external alternatives; no need for x to be within the scope of an operator since the set of external alternatives is not introduced by a particular operator

(b) Internal variation requirement: dependent indefinites – x must have different values relative to internal alternatives; x must be within the semantic scope of an (internal) alternative introducing expression

Types of stability constraints:

(i) constraining the domain: partitives

  - partitives (*one of the girls*) restrict domain to subset of familiar set: limit potential of external variation (relative to a non-partitive such as *a girl*)

(ii) direct constraints on referents: uniqueness-in-context (determinacy) for definite articles, identifiability in principle for *a certain*-type indefinites

(iii) indirect specificity constraint: constraint that indirectly interacts with stability/variation across alternatives:

  - information structure constraint concerning topicality for *this* indefinites
  - deictic or other referential constraint for demonstratives, I/II personal pronouns

Consequences for semantic scope:
The stability/variation constraint for a particular DP may/may not result in scopal constraints:

- partitive constraint is neutral wrt scope: we expect partitives to be able to scope within/outside any quantifier/operator

(4) Alice wants/doesn't want to marry one of Phil's borthers.

- topicality constraint may prevent a DP from scoping under certain operators or quantifiers but not others; *this*-indefinites like wide scope because of high salience; wide scope is not absolute requirement.

(5) I work in electronic and auto shows. Companies hire me to stay in their booth and talk about products. I have this speech to tell. (Prince 1981, p. 233)

- identifiability constraint makes *certain*-indefinites incompatible with being within the scope of *want*-type operators but compatible with being in the scope of doxastic/epistemic operators.

(6) Alice thinks that a certain unicorn is eating her cabbage./Alice wants Phil to catch a certain unicorn.

Anti-specifier constraint relative to external alternatives: independent of internal scope.
Anti-specifier constraint relantive to internal alternatives: requires DP do be within the scope of an internal alternative introducing expression.

- dependent indefinite constraint requires DP to be in an environment that provides the internal alternatives it needs

Upshot: semantics of D/DP predicts scopal behavior.

3 Preview of Dependent Indefinites

- special complex indefinites that must be interpreted as co-varying with another variable introduced by a licensor, and therefore necessarily interpreted within the scope of that licensor (Farkas 1997b)
- associated with:
  - reduplicative morphology (Hungarian, Bengali, Georgian, Pashto)
  - affixation (Basque, Turkish, Maori)
  - free standing extra morpheme (Romanian, Russian, German, Latvian)

(see Pereltsvaig 2008, who notes that The World Atlas of Language Structures Online lists 189 languages that have dependent indefinites)

(7) Minden vonás **egy-egy** emlék.
every feature a-a memory
'Every feature is a memory.'

(8) Azzal **egy-egy** puszit nyomott az arcunkra és beült a taxiba.
with.that a-a kiss planted the face.Ipos.Pl and sat-in the cab.in
'With that [she] planted a kiss on our faces and took the cab.'

(9) Olykor-olykor **egy-egy** ember felkiáltott.
occasionally *a-a* man cried-out
'Occasionally a man cried out.'

Possible licensors in Hungarian:

(a) *bona fide* quantified DP (7)

(b) distributively interpreted plurals (8)

(c) an adverb of quantification (9)

Typology of dependent indefinites
extra sortal restrictions on the variable the indefinite covaries with (is dependent on).

- Hungarian indefinites: licensing variable cannot be a variable over worlds; in Russian it can
- Hungarian cardinal indefinites: licensing variable cannot be a variable over situations / eventualities

(10) *Mari kell találkozzon **egy-egy** párizsi tanárral.
Mari must meet *a-a* Paris.from professor.with
'Mari must meet a professor from Paris.'

(11) *Olykor-olykor **két-két** ember felkiáltott.
occasionally *two-two* man cried-out
'Occasionally two men cried out.'

Plan: next section gives an account of neutral indefinites and their scopal potential; Section 5 presents an account of dependent indefinites in terms that make direct reference to variation across alternatives.

4 Neutral indefinites in First Order Logic with Choice (C-FOL)

4.1 The problem of too much freedom

Basic property: no special constraint (besides whatever renders them indefinite).
Corollary: freedom of scope.
Classical problem: unlike universals, indefs enjoy free upward scope disregarding clausal and island boundaries (Farkas 1981, Fodor & Sag 1982, Abusch 1994 among many others).

(12) Every^x student read every^y paper that a^z professor recommended.

- the indefinite may scope over the direct-object universal or over both universals
- three possible readings depending on the relation between the indefinite and each universal
  - narrowest-scope (NS):
    for every student x,
      for every paper y such that
    $\Longrightarrow$ there is a professor z that recommended y,
          x read y
  - intermediate-scope (IS):
    for every student x,
    $\Longrightarrow$ there is a professor z such that,
        for every paper y that z recommended,
          x read y
  - widest-scope (WS):
    $\Longrightarrow$ there is a professor z such that,
      for every student x,
        for every paper y that z recommended,
          x read y

(ii) the upward scope of universals is clause-bounded

(13) John read a^x paper that every^y professor recommended.

- the universal cannot scope over the indefinite: no co-variation possible between professors and paper

The problem: scopal freedom of neutral indefinites is problematic for syntax-based accounts of relative scope; configurational matters cannot be disregarded altogether either

Configurational constraint:

(14) Every^x student read every^y paper that one^z of its$_y$ authors recommended.

The indefinite *one^z of its$_y$ authors* can have only narrowest scope.

(15) *Binder Roof Constraint*: an indefinite cannot scope over a quantifier that binds into its Restrictor. (Abusch 1994, Chierchia 2001, Schwarz 2001)

4.2 Outline of the Proposal

- interpret indefinites *in situ* thereby partially divorcing semantic scope from configurational matters (see Dekker (2008), Steedman 2007, Farkas 1997a)
- depart from previous linguistic accounts in conceptualizing scope as a matter of *independence* by marking when the interpretation of an expression must be *rigid* (invariant) relative to another
- main role of syntactic structure: if a quantifier $\mathbf{Q}x$ structurally commands a quantifier $\mathbf{Q}'y$, x becomes available for y to potentially co-vary with or be independent of
- just as in choice / Skolem function approaches, we take the essence of the semantics of indefinites to be choosing a witness
- unlike choice / Skolem function approaches and like independence-friendly (IF) logic: witness choice is part of the interpretation procedure
- indefinites choose a witness *at some point in the evaluation* and require its non-variation from that point on
- non-variation is ensured by directly constraining the values taken by the *first-order* variable contributed by the indefinite
- an indefinite is indexed with the set of variables it is *dependent on*, and requires *non-variation* relative to all the other variables

An existential:

- accesses the set $\mathcal{V}$ of variables previously introduced by quantifiers taking syntactic scope over the existential
- chooses a subset $\mathcal{V}'$ of $\mathcal{V}$ relative to which the values of the witness may co-vary (in the spirit of Steedman 2007)

– the variables in $\mathcal{V}'$ are those the existential may be dependent on

– the variables in $\mathcal{V} \setminus \mathcal{V}'$ are those that the existential is independent of

(16) $\forall x[\phi]\ (\forall y[\phi']\ (\exists z[\phi'']\ (\psi)))$

(17) $\mathcal{V} = \{x, y\}$

(18)

Narrowest scope (NS): $\mathcal{V}' = \{x, y\}$	z is fixed relative to no variable, i.e., z (possibly) covaries with both x and y
Intermediate scope (IS): $\mathcal{V}' = \{x\}$	z is fixed relative to y and (possibly) covaries with x
Widest scope (WS): $\mathcal{V}' = \emptyset$	z is fixed relative to both x and y

For simplicity, we ignore the 'non-surface' IS determined by $\mathcal{V}' = \{y\}$.

Example

(19) Every^x professor recommended every^y paper to a^z student.

(20)
$$\begin{array}{l}\forall x[\textsc{professor}(x)] \\ \quad (\forall y[\textsc{paper}(y)] \\ \qquad (\exists z[\textsc{student}(z)] \\ \qquad\quad (\textsc{recommend-to}(x, y, z))))\end{array}$$

Assume:

- the set of professors x is $\{\alpha_1, \alpha_2\}$
- the set of papers y is $\{\beta_1, \beta_2\}$

The existential $\exists z$ chooses a witness that satisfies its Restrictor $\textsc{student}(z)$ and its nuclear scope $\textsc{recommend-to}(x, y, z)$.
The set of variables contributed by previously evaluated quantifiers: $\mathcal{V} = \{x, y\}$.

Scope depicted in matrices with index choices $\{x, y\}$, $\{x\}$, $\emptyset$:

(21)

NS

x	y	z
α_1	β_1	γ
α_1	β_2	γ'
α_2	β_1	γ''
α_2	β_2	γ'''

IS

x	y	z
α_1	β_1	γ
α_1	β_2	
α_2	β_1	γ'
α_2	β_2	

WS

x	y	z
α_1	β_1	γ
α_1	β_2	
α_2	β_1	
α_2	β_2	

Requirement imposed by dependent indefinites:

- witness choice must co-vary with some other varying variable

As a result: the WS matrix in (21) is not possible if the variable z is introduced by a dependent indefinite.
Role of syntax: syntactic scope of the universals determines the possible parameters of dependency of the indefinite.

Questions to be addressed below:

- how should such matrices be formalized?
- how should we treat the variation requirement that may be contributed by the existential?

4.3 Scope in First-Order Logic with Choice (C-FOL)

The essence of scope in natural language semantics:

- does the interpretation of an expression e_1 affect the interpretation of another expression e_2 or not?

(22) Every^x student in my class read a^y paper about scope.

How can we tell whether the interpretation of $\mathbf{Q}'y$ (*a paper about scope*) was affected by $\mathbf{Q}x$ (*every student*)?

- $\mathbf{Q}'y$ is in the scope of $\mathbf{Q}x$: y may co-vary with x
- $\mathbf{Q}'y$ is outside the scope of $\mathbf{Q}x$: y's value is fixed relative to x

Classical conceptualization:

- syntactic position of $\mathbf{Q}'y$ determines whether it is/is not in the semantic scope of $\mathbf{Q}x$

(In)dependence based approach adopted here: scopal relations as direct (in)dependence relations among variables

- $\exists y$ is in the scope of $\forall x$: values of y co-vary with varying values of x
- if $\exists y$ is outside the scope of $\forall x$: values of y are fixed relative to the varying values of x

Dependence/independence relation between variables: captured directly in the semantics rather than indirectly via syntactic structure.

4.3.1 Two formal novelties in the semantics

(i) formulas are evaluated relative to *sets* of assignments $G, G', \ldots$ instead of single assignments $g, g', \ldots$ (see Hodges 1997,Väänänen 2007); needed in order to be able to talk about (in)dependent values for y relative to varying values for x

- the interpretation function has the form $[\![\cdot]\!]^{\mathfrak{M},G}$

Internal alternatives: set of assignments G each of which verifies e; in most cases, G is singleton.
External alternatives: set $\mathcal{G}$ of sets of assignments.

(ii) the index of evaluation for a quantifier contains the set $\mathcal{V}$ of variables introduced by the previously evaluated (i.e., syntactically higher) quantifiers or operators

- the interpretation function has the form $[\![\cdot]\!]^{\mathfrak{M},G,\mathcal{V}}$

Needed to capture the syntactic side of scopal relations: co-variation of an existential is possible only relative to a subset of the previously introduced (higher) variables.

Use of sets of assignments

A set of total assignments G:

(23)

G	$\ldots$	x	y	z	$\ldots$
g_1	$\ldots$	α_1 $(= g_1(x))$	β_1 $(= g_1(y))$	γ_1 $(= g_1(z))$	$\ldots$
g_2	$\ldots$	α_2 $(= g_2(x))$	β_2 $(= g_2(y))$	γ_2 $(= g_2(z))$	$\ldots$
g_3	$\ldots$	α_3 $(= g_3(x))$	β_3 $(= g_3(y))$	γ_3 $(= g_3(z))$	$\ldots$
$\ldots$	$\ldots$	$\ldots$	$\ldots$	$\ldots$	$\ldots$

- independence of $\mathbf{Q}''z$ from $\mathbf{Q}'y$: z has to have a fixed value relative to the (possibly) varying values of y

(24) Fixed value condition (basic version): for all $g, g' \in G$, $g(z) = g'(z)$.

- if z does not co-vary with y, this means that:
  - $\mathbf{Q}''z$ is not in the *semantic* scope of $\mathbf{Q}'y$ (although it may very well be in its *syntactic* scope)
- $\mathbf{Q}x$ may take both syntactic and semantic scope over $\mathbf{Q}''z$ (intermediate scope (IS) in (21)): value of z is fixed relative to y, but may co-vary with x

We need to be able to relativize the fixed value condition for z to the variable x.

(25) Fixed value condition (relativized version):
for all $g, g' \in G$, if $g(x) = g'(x)$, then $g(z) = g'(z)$.

- the values of z may co-vary with x but are fixed relative to other variables (y in our example)

(26)

x	y	z
α_1	β_1	γ
α_1	β_2	
α_2	β_1	γ'
α_2	β_2	

- advantage of *sets* of assignments over single assignments: we can formulate non-variation / fixed-value conditions relativized to particular variables
- still needed: way of keeping track of the variables introduced by the syntactically higher quantifiers so as to relativize such conditions to particular quantifiers

Use of a set of variables as indices on existentials

- index of evaluation contains the set of variables $\mathcal{V} = \{x, y, \ldots\}$ introduced by previous quantifiers; these are the variables the existential *could* co-vary with
- an existential has a choice: chooses which of the variables that take syntactic scope over the existential also take semantic scope over it
- $\mathcal{V}' \subseteq \mathcal{V} = \{x, y, \ldots\}$; variables in $\mathcal{V}'$ are the variables that the indefinite is possibly dependent on
- the complement set of variables $\mathcal{V} \setminus \mathcal{V}'$: the variables relative to which the indefinite does *not* vary, i.e., the variables that the indefinite is independent of
- the C in our C-FOL stands for this choice

(27) An indefinite that is in the syntactic scope of a quantifier binding a variable x_n is in its semantic scope iff x_n is in $\mathcal{V}'$.

Empirical predictions

(i) an indefinite may be within the semantic scope of a quantifier $\mathbf{Q}x$ only if $\mathbf{Q}x$ has syntactic scope over that indefinite (more generally: only if the semantic composition makes it so that the quantifier $\mathbf{Q}x$ is evaluated before the indefinite)

(ii) an indefinite may in principle be outside the semantic scope of a quantifier that takes syntactic scope over it

4.4 Existentials in C-FOL

Choice in existential quantification: superscript $\mathcal{V}'$ that determines which variables the existential may co-vary with.

- such a superscript can only occur on existentials – and not on *bona fide* quantifiers
- this is because these superscripts constrain witness choice – and the semantics of *bona fide* quantifiers cannot be given in terms of single witnesses

(28) Existential quantification:
$[\![\exists^{\mathcal{V}'} x[\phi]\ (\psi)]\!]^{\mathfrak{M},G,\mathcal{V}} = \mathbb{T}$ iff $\mathcal{V}' \subseteq \mathcal{V}$ and $[\![\psi]\!]^{\mathfrak{M},G',\mathcal{V}\cup\{x\}} = \mathbb{T}$, for some G' such that

a. $G'[x]G$

b. $[\![\phi]\!]^{\mathfrak{M},G',\mathcal{V}'\cup\{x\}} = \mathbb{T}$

c. $\begin{cases} \text{if } \mathcal{V}' = \emptyset : g(x) = g'(x), \text{ for all } g, g' \in G' \\ \text{if } \mathcal{V}' \neq \emptyset : g(x) = g'(x), \text{ for all } g, g' \in G' \text{ that are } \mathcal{V}'\text{-identical} \end{cases}$

(29) Two assignments g and g' are $\mathcal{V}'$-identical iff for all variables $\upsilon \in \mathcal{V}'$, $g(\upsilon) = g'(\upsilon)$.

- the nuclear scope formula ψ is interpreted relative to $\mathcal{V} \cup \{x\}$
- the Restrictor formula ϕ is interpreted relative to $\mathcal{V}' \cup \{x\}$; consequently the Restrictor formula has the same semantic scope as the existential
- if $\mathcal{V}' = \emptyset$, the value of the existential is fixed, and the indefinite has widest scope and it is given values in terms of (24)
- if $\mathcal{V}' \neq \emptyset$, the fixed value condition is relativized to the variables in $\mathcal{V}'$ and the indefinite is given values in terms of the relativized fixed value condition in (25)

4.5 Universals in C-FOL

The basic idea:

- the nuclear scope is evaluated relative to the set of *all* g' that satisfy the Restrictor
- hence: collect in G' all g' that satisfy the Restrictor ϕ and evaluate the nuclear scope ψ relative to G'

Restrictor of a universal: interpreted relative to the set of assignments G' taken *collectively*, as a whole (rather than distributively, one by one), in a way that parallels the interpretation of the NS of an existential.

(30) $[\![\forall x[\phi]\ (\psi)]\!]^{\mathfrak{M},G,\mathcal{V}} = \mathbb{T}$ iff $[\![\psi]\!]^{\mathfrak{M},G',\mathcal{V}\cup\{x\}} = \mathbb{T}$, for some G' that is a maximal set of assignments relative to x, ϕ, G and $\mathcal{V}$.

(31) G' is a maximal set of assignments relative to a variable x, a formula ϕ, a set of assignments G and a set of variables $\mathcal{V}$ iff

a. $G'[x]G$ and $[\![\phi]\!]^{\mathfrak{M},G',\mathcal{V}\cup\{x\}} = \mathbb{T}$

b. there is no $G'' \neq G'$ such that $G' \subseteq G''$ and:
$G''[x]G$ and $[\![\phi]\!]^{\mathfrak{M},G'',\mathcal{V}\cup\{x\}} = \mathbb{T}$

Note the existential force of this: "some / a maximal set" and not "the maximal set".

- there might be multiple such maximal sets of assignments
- for instance, if the Restrictor ϕ of the universal contains an indefinite, the variable it introduces could take several distinct witnesses as values and a distinct maximal set of assignments would result for each such witness

4.6 Existentials in the scope of universals – an example

(32) Every^x student read a^y paper.

(33) $\forall x[\textsc{student}(x)]\ (\exists^{\emptyset} y[\textsc{paper}(y)]\ (\textsc{read}(x,y)))$

(34) $\forall x[\textsc{student}(x)]\ (\exists^{\{x\}} y[\textsc{paper}(y)]\ (\textsc{read}(x,y)))$

- if superscript is $\emptyset$, as in (33): the existential has wide-scope interpretation
- if superscript is $\{x\}$, as in (34): the existential has narrow-scope interpretation relative to the universal

The two readings: same syntax; the difference lies solely in the semantics and involves the way the witness is chosen.

- the presence of the universal makes possible two ways of choosing the witness: as dependent or as independent of the variable bound by the universal

Interpretation relative to an arbitrary G and the empty set of variables $\emptyset$:

(35) Truth: a formula ϕ is true in model $\mathfrak{M}$ iff $[\![\phi]\!]^{\mathfrak{M},G,\emptyset} = \mathbb{T}$ for any non-empty set of assignments G, where $\emptyset$ is the empty set of variables.

Assume that the set of students in $\mathfrak{M}$ is $\{stud_1, stud_2, stud_3\}$.

(i) $\forall x[\textsc{student}(x)]$ introduces the set of all students relative to the variable x and stores them one by one in the assignments $g \in G$

(ii) $\exists^{\emptyset/\{x\}} y[\text{PAPER}(y)]$ introduces a paper and chooses whether it is the same for every student (if the superscript is $\emptyset$) or whether it is possibly different from student to student (if the superscript is $\{x\}$)

(iii) each assignment in the resulting set should be such that the x-student in that assignment read the y-paper in that assignment.

(36)
$$
\begin{array}{|c|c|c|c|}
\multicolumn{1}{c}{\dots} & \multicolumn{1}{c}{\dots} & \multicolumn{1}{c}{\dots} & \multicolumn{1}{c}{\dots} \\ \hline
\dots & \dots & \dots & \dots \\ \hline
\end{array}
\xRightarrow{\forall x[\text{STUDENT}(x)]}
\begin{array}{|c|c|c|c|}
\multicolumn{1}{c}{\dots} & \multicolumn{1}{c}{x} & \multicolumn{1}{c}{\dots} & \multicolumn{1}{c}{\dots} \\ \hline
\dots & stud_1 & \dots & \dots \\ \hline
\dots & stud_2 & \dots & \dots \\ \hline
\dots & stud_3 & \dots & \dots \\ \hline
\end{array}
$$

$$
\left\{
\begin{array}{l}
\xRightarrow{\exists^{\emptyset} y[\text{PAPER}(y)]}
\begin{array}{|c|c|c|c|}
\multicolumn{1}{c}{\dots} & \multicolumn{1}{c}{x} & \multicolumn{1}{c}{y} & \multicolumn{1}{c}{\dots} \\ \hline
\dots & stud_1 & & \dots \\ \cline{1-2}\cline{4-4}
\dots & stud_2 & paper & \dots \\ \cline{1-2}\cline{4-4}
\dots & stud_3 & & \dots \\ \hline
\end{array}
\xRightarrow{\text{READ}(x,y)}
\begin{array}{l}
stud_1 \text{ read } paper \\
stud_2 \text{ read } paper \\
stud_3 \text{ read } paper
\end{array}
\\[2ex]
\xRightarrow{\exists^{\{x\}} y[\text{PAPER}(y)]}
\begin{array}{|c|c|c|c|}
\multicolumn{1}{c}{\dots} & \multicolumn{1}{c}{x} & \multicolumn{1}{c}{y} & \multicolumn{1}{c}{\dots} \\ \hline
\dots & stud_1 & paper & \dots \\ \hline
\dots & stud_2 & paper' & \dots \\ \hline
\dots & stud_3 & paper'' & \dots \\ \hline
\end{array}
\xRightarrow{\text{READ}(x,y)}
\begin{array}{l}
stud_1 \text{ read } paper \\
stud_2 \text{ read } paper' \\
stud_3 \text{ read } paper''
\end{array}
\end{array}
\right.
$$

Capturing the Binder Roof Constraint

Recall (15): indefinite cannot scope over a quantifier that binds into its Restrictor.

- by (28), the Restrictor ϕ of an indefinite is interpreted only relative to the variables in $\mathcal{V}'$
- the Binder Roof Constraint follows because the semantic scope of the Restrictor ϕ is always the same as the semantic scope of the existential $\exists^{\mathcal{V}'}$
- if the indefinite *one*^{z} *of its*$_y$ *authors* in (14) is independent from the universal *every*^{y} *paper*, the variable y contributed by *its*$_y$ is free and this is ruled out by the interpretation clause for atomic formulas in (50)

Deriving Exceptional Scope

(37) Every^x student read every^y paper that a^z professor recommended.

(38)
$$
\begin{array}{l}
\forall x[\text{STUDENT}(x)] \\
\quad (\forall y[\text{PAPER}(y) \wedge \\
\qquad \exists^{\emptyset/\{x\}/\{x,y\}} z[\text{PROFESSOR}(z)]\ (\text{RECOMMEND}(z,y))] \\
\qquad\quad (\text{READ}(x,y)))
\end{array}
$$

WS, IS and NS: choice of superscript fixed to $\emptyset$, $\{x\}$ or $\{x,y\}$ (given that $\mathcal{V} = \{x,y\}$).

- IS reading (superscript $= \{x\}$): for each student x, we choose a professor z and require x to have read every paper that z recommended; professors may co-vary with the students but not with the papers

4.7 Interim conclusions

(i) indefinites are interpreted *in situ*

(ii) difference in scope potential between existentials and universals is accounted for in terms of essential interpretive procedure difference

(iii) freedom of scope of neutral indefinites involves no special mechanism

(iv) the formal framework allows us to impose co-variation/stability requirements directly

5 Dependent Indefinites in C-FOL

Ingredients of analysis of ordinary indefinites:

- the superscript on the existential that stores the set of parameters relative to which the indefinite may co-vary
- the fixed-value constraint that makes use of this superscript and that constrains the values of the indefinite stored in the resulting matrix

Expectation: existence of special indefinites that target the same superscript and possibly enforce further constraints on the values stored in the matrix.

Essence of dependent indefinites

- dependent indefinites add a *non-fixed / evaluation plural* value condition relativized to their superscript

Interpretation rule for dependent indefinites:

(39) $[\![\textbf{dep-}\exists^{\mathcal{V}'} x[\phi]\ (\psi)]\!]^{\mathfrak{M},G,\mathcal{V}} = \mathbb{T}$ iff $\mathcal{V}' \subseteq \mathcal{V}$ and $[\![\psi]\!]^{\mathfrak{M},G',\mathcal{V}\cup\{x\}} = \mathbb{T}$, for some G' such that

a. $G'[x]G$

b. $[\![\phi]\!]^{\mathfrak{M},G',\mathcal{V}'\cup\{x\}} = \mathbb{T}$

c. $\begin{cases} \text{if } \mathcal{V}' = \emptyset : g(x) = g'(x), \text{ for all } g, g' \in G' \\ \text{if } \mathcal{V}' \neq \emptyset : g(x) = g'(x), \text{ for all } g, g' \in G' \text{ that are } \mathcal{V}'\text{-identical} \end{cases}$

d. $g(x) \neq g'(x)$, for at least two $g, g' \in G'$ that are not $\mathcal{V}'$-identical **new!**

(40) Two assignments g and g' are $\mathcal{V}'$-identical iff for all variables $\upsilon \in \mathcal{V}'$, $g(\upsilon) = g'(\upsilon)$.

Effect of (39d) is to impose co-variation of values for x, the variable introduced by the dependent indefinite, with some other variable υ that varies across internal alternatives.

- $\mathcal{V}'$ must be non-empty because there must be at least two assignments $g, g' \in G'$ that are not $\mathcal{V}'$-identical
  - that is, there must be a variable $\upsilon \in \mathcal{V}'$ such that $g(\upsilon) \neq g'(\upsilon)$
- hence, the fixed-value condition is reduced to the second case in which $\mathcal{V}' \neq \emptyset$
- licensor must be an expression that introduces multiple values for the same variable (because we need assignments that are $\mathcal{V}'$-non-identical); in our system this can be done by *bona fide* quantifiers but not by an existential.

Example

(41) Minden^x diák olvasott egy-egy^y cikket.
every student read a-a paper
'Every student read a paper.'

(42) $\forall x[\text{STUDENT}(x)]$ ($\textbf{dep-}\exists^{*\emptyset\,/\,\checkmark\{x\}} y[\text{PAPER}(y)]$ ($\text{READ}(x, y)$))

(43)

...	...	...	...
...	...	...	...

$\xrightarrow{\forall x[\text{STUDENT}(x)]}$

...	x	...	...
...	$stud_1$	...	...
...	$stud_2$	...	...
...	$stud_3$	...	...

$\xrightarrow{\textbf{dep-}\exists^{*\emptyset} y[\text{PAPER}(y)]}$

...	x	y	...
...	$stud_1$		...
...	$stud_2$	*paper*	...
...	$stud_3$		...

condition (39d) is not satisfied: for all g, g', $g(y) = g'(y) = paper$

$\xrightarrow{\textbf{dep-}\exists^{\checkmark\{x\}} y[\text{PAPER}(y)]}$

...	x	y	...
...	$stud_1$	*paper*	...
...	$stud_2$	*paper*$'$	...
...	$stud_3$	*paper*$''$	...

$\xrightarrow{\text{READ}(x,y)}$ $stud_1$ read *paper*
$stud_2$ read *paper*$'$
$stud_3$ read *paper*$''$

Details of the evaluation of (41):

(i) the Restrictor of $\forall x$ introduces the set of all students in column x

(ii) moving to the existential, if $\mathcal{V}' = \emptyset$, variation condition (39d) is not satisfied because y has a single value

(iii) existential must have the superscript $\{x\}$, which makes covariation of papers with students possible

(iv) condition (39d) requires actual rather than merely possible covariation

(v) the nuclear scope of the existential checks that each x-student read the corresponding y-paper

Some consequences

- we have isolated the contribution of dependent morphology making dependent indefinites ordinary indefinites + a special condition
- dependent indefinites end up being *evaluation plurals* in the sense of Brasoveanu (2008) (as opposed to the usual non-atomic individuals, which are ontologically plural): requirement that there be more than one witness in the y column
- this can be generalized to pluractionality (more than one event)

(44) A gyerek **fel-fel** ébredt.
the child up-up woke
'The child kept waking up.'

- in (44): covariation of events of waking up with time-points/intervals
- special sortal conditions on the licensing variable can be imposed
- Hungarian reduplicated indefinites cannot be licensed by modals (or by an ordinary indefinite within the scope of a modal)
- Russian dependent indefinites can (see Pereltsvaig 2008)
- the semantic rule in (39) above is correct for Russian, but needs to be further refined for Hungarian

(45) $[\![\textbf{dep-}\exists^{\mathcal{V}'} x[\phi]\ (\psi)]\!]^{\mathfrak{M},G,\mathcal{V}} = \mathbb{T}$ iff $\mathcal{V}' \subseteq \mathcal{V}$ and $[\![\psi]\!]^{\mathfrak{M},G',\mathcal{V}\cup\{x\}} = \mathbb{T}$, for some G' such that

a. $G'[x]G$

b. $[\![\phi]\!]^{\mathfrak{M},G',\mathcal{V}'\cup\{x\}} = \mathbb{T}$

c. $\begin{cases} \text{if } \mathcal{V}' = \emptyset : g(x) = g'(x), \text{ for all } g, g' \in G' \\ \text{if } \mathcal{V}' \neq \emptyset : g(x) = g'(x), \text{ for all } g, g' \in G' \text{ that are } \mathcal{V}'\text{-identical} \end{cases}$

d. $g(x) \neq g'(x)$, for at least two $g, g' \in G'$ that are $\mathcal{V}'_{\mathfrak{W}}$-identical but not $\mathcal{V}'_{\mathfrak{D}}$-identical

(46) For any set of variables $\mathcal{V}'$, $\mathcal{V}'_{\mathfrak{D}}$ is the set of variables over individuals in $\mathcal{V}'$ and $\mathcal{V}'_{\mathfrak{W}}$ is the set of variables over worlds in $\mathcal{V}'$.

(47) Two assignments g and g' are $\mathcal{V}'$-identical iff for all variables $\upsilon \in \mathcal{V}'$, $g(\upsilon) = g'(\upsilon)$.

6 Conclusion

Back to specificity:

(i) crucial feature of the formal mechanism we propose is that it allows us to talk directly of (co)-variation/stability of value choice for existentials

(ii) this is essential in giving an account of dependent indefinites, which are non-specific in a very specific way: they require co-variation of value choice relative to another varying variable

(iii) we can express this property directly as a requirement imposed by the special dependent morphology of dependent indefinites that ensures evaluation plurality

(iv) other types of variation / stability requirements imposed by other special Ds are both expected and expressible

(v) the account of neutral indefinites we proposed captures their freedom of scope as well as the syntactic constraints on it as a result of the lack of special requirements associated with such indefinites

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Appendix: Basic C-FOL notions

- the heart of the account – the recursive definition of the interpretation function $[\![\cdot]\!]^{\mathfrak{M},G,\mathcal{V}}$
- a model $\mathfrak{M}$ for C-FOL has the same structure as the standard models for FOL: $\mathfrak{M}$ is a pair $\langle \mathfrak{D}, \mathfrak{I} \rangle$
  - $\mathfrak{D}$ is the domain of individuals
  - $\mathfrak{I}$ the basic interpretation function
  - when we need it, we can add the set of possible worlds $\mathfrak{W}$ and relativize $\mathfrak{I}$ to this set in the usual way
- an $\mathfrak{M}$-assignment g for C-FOL is also defined just as in FOL: g is a total function from the set of variables $\mathcal{VAR}$ to $\mathfrak{D}$, i.e., $g \in \mathfrak{D}^{\mathcal{VAR}}$

The essence of quantification in FOL: pointwise (i.e., variablewise) manipulation of variable assignments.

- $g'[x]g$ abbreviates that the assignments g' and g differ at most with respect to the value they assign to x

(48) $g'[x]g :=$ for all variables $\upsilon \in \mathcal{VAR}$, if $\upsilon \neq x$, then $g'(\upsilon) = g(\upsilon)$

We work with sets of variable assignments, so we generalize this to a notion of pointwise manipulation of sets of assignments.

- $G'[x]G$ is just the cumulative-quantification style generalization of $g'[x]g$ – any $g' \in G'$ has an $[x]$-predecessor $g \in G$ and any $g \in G$ has an $[x]$-successor $g' \in G'$

(49) $$G'[x]G := \begin{cases} \text{for all } g' \in G', \text{ there is a } g \in G \text{ such that } g'[x]g \\ \text{for all } g \in G, \text{ there is a } g' \in G' \text{ such that } g'[x]g \end{cases}$$

The interpretation of atomic formulas:

(50) Atomic formulas: $[\![R(x_1, \dots, x_n)]\!]^{\mathfrak{M},G,\mathcal{V}} = \mathbb{T}$ iff

a. $\{x_1, \dots, x_n\} \subseteq \mathcal{V}$

b. $G \neq \emptyset$

c. $\langle g(x_1), \dots, g(x_n) \rangle \in \mathfrak{I}(R)$, for all $g \in G$

(51)

G	$\dots$	x_1	$\dots$	x_n	$\dots$
g	$\dots$	$\alpha_1\ (= g(x_1))$	$\dots$	$\alpha_n\ (= g(x_n))$	$\dots$
		$\langle \alpha_1, \dots, \alpha_n \rangle \in \mathfrak{I}(R)$			
g'	$\dots$	$\beta_1\ (= g'(x_1))$	$\dots$	$\beta_n\ (= g'(x_n))$	$\dots$
		$\langle \beta_1, \dots, \beta_n \rangle \in \mathfrak{I}(R)$			
g''	$\dots$	$\gamma_1\ (= g''(x_1))$	$\dots$	$\gamma_n\ (= g''(x_n))$	$\dots$
		$\langle \gamma_1, \dots, \gamma_n \rangle \in \mathfrak{I}(R)$			
$\dots$	$\dots$	$\dots$	$\dots$	$\dots$	$\dots$

- bans free variables – condition (50a)
  - deictic pronouns require the discourse-initial set of variables $\mathcal{V}$ to be non-empty – much like the discourse-initial partial assignments in DRT/FCS are required to have a non-empty domain

- distributes over the set G and, in this way, relates the C-FOL notion of set-based satisfaction to the standard FOL notion of single-assignment-based satisfaction – condition (50c) below
- the non-emptiness condition (50b) rules out the case in which the distributive requirement in (50c) is vacuously satisfied

Conjunction – interpreted as usual: we just pass the current index of evaluation down to each conjunct.

(52) Conjunction: $[\![\phi \wedge \psi]\!]^{\mathfrak{M},G,\mathcal{V}} = \mathbb{T}$ iff $[\![\phi]\!]^{\mathfrak{M},G,\mathcal{V}} = \mathbb{T}$ and $[\![\psi]\!]^{\mathfrak{M},G,\mathcal{V}} = \mathbb{T}$.

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