Wide Scope Indefinites

Yasutada Sudo

PLIN0056 Semantic Research Seminar 2022: Week 2

Week 1 ~~7 October: Referential indefinites and wide scope~~

Week 2 14 October: Choice functions

- Reading: Schwarz 2011
- Optional reading: Reinhart 1997, Winter 1997, Kratzer 1998, Matthewson 1998, Chierchia 2001, Schwarz 2001, Schlenker 2006

Week 3 21 October: Pied-piping and scope

- Reading: Charlow 2020
- Optional reading: Demirok 2019: Ch. 4

Week 4 28 October: Indefinites and presuppositions

- Reading: Geurts 2010
- Optional reading: Van Geenhoven 1998, Onea 2015

Week 5 4 November: A neo-Heimian theory of indefinites with exceptional scope

- Reading: von Fintel 1998, Heim 2011
- Optional reading: Heim 1982

Other readings

- Historical account: Ruys 2001
- Detailed overview articles: Ruys & Spector 2017, Ebert 2021

1 Choice functions

1.1 Definition

Choice functions take a non-empty set and return a member of the set.

(1) A function f from sets of individuals to individuals is a *choice function*, if for each non-empty set S, $f(S) \in S$.

Let $\mathsf{CF} := \{ f \mid f \text{ is a choice function} \}$.
According to (1), a choice function maps $\varnothing$ to an arbitrary individual, but this is arguably not good for natural language applications. We'll discuss the modifications proposed by Winter 1997, 2001 later.

1.2 Choice function indefinites

Reinhart 1997 and Winter 1997 propose to use choice functions to account for indefinites with exceptional scope.
When no confusion arises, I'll write $f(P)$ for $f(\{x \mid P(x)\})$.

(2) A woman entered.
  a. $\exists f \in \mathsf{CF}[E(f(W)]$
  b. 'There is some way f of choosing a woman such that the woman chosen by f entered.

(3) If some relative of Mary's dies, she'll inherit a fortune.
  a. $\exists f \in \mathsf{CF}[(D(f(\{x \mid R(x,m)\}))) \to I(m)]$
  b. 'There is a way f of choosing a relative of Mary's such that if the relative of Mary's chosen by f dies, Mary will inherit a fortune.'

(4) John has looked at every analysis that solves some problem mentioned in the textbook. (Schwarz 2011: p. 881)
  a. $\exists f \in \mathsf{CF}[\forall x[(A(x) \wedge S(x, f(P))) \to L(j,x)]$
  b. 'There's a way f of choosing a problem such that John looked at every analysis that solves the problem chosen by f.'

Reinhart 1997 assumes that indefinites are ambiguous between a choice function reading and an ordinary quantificational reading, the latter of which obeys the scope contraints (also Kratzer 1998, Matthewson 1998), and Winter 1997, 2001 argues against that, but this difference doesn't concern us here. With Winter 1997, 2001, we'll assume that indefinites are always choice-functional for the sake of simplicity.

1.3 Some compositional details

A Heim-and-Kratzer style implementation in an extensional system:

(5) a. $[\![\textbf{cat}]\!]^g = \lambda x_e.\ x$ is a cat
  b. $[\![\textbf{purred}]\!]^g = \lambda x_e.\ x$ purred

(6) a. $[\![\textbf{a}_\xi]\!]^g = [\![\textbf{some}_\xi]\!]^g = \lambda P_{\langle e,t\rangle}.\ g(\xi)(\{x \mid P(x) = 1\})$
  b. $[\![\textbf{a}_\xi\ \textbf{cat}]\!]^g = [\![\textbf{some}_\xi\ \textbf{cat}]\!]^g = g(\xi)(\{x \mid [\![\textbf{cat}]\!]^g(x) = 1\})$

(7) EXISTENTIAL CLOSURE: For any constituent ϕ of type t,
$$\left[\!\!\left[\ [\ \exists^\xi\quad \phi\ ]\ \right]\!\!\right]^g = 1 \text{ iff for some } f \in \mathsf{CF},\ [\![\phi]\!]^{g[\xi \mapsto f]} = 1$$

$$\left[\!\!\left[\;[\, \exists^3 \;[_{DP}\ \mathbf{a}_3\ \mathbf{cat}\,]\ [_{VP}\ \mathbf{purred}\,]\,] \;\right]\!\!\right]^g = 1$$

$$\text{iff for some } f \in \mathsf{CF},\ \left[\!\!\left[\;[\,[_{DP}\ \mathbf{a}_3\ \mathbf{cat}\,]\ [_{VP}\ \mathbf{purred}\,]\,] \;\right]\!\!\right]^{g[3\mapsto f]}$$

$$= [\![\mathbf{purred}]\!]^{g[3\mapsto f]}\left(\left[\!\!\left[[_{DP}\ \mathbf{a}_3\ \mathbf{cat}\,] \right]\!\!\right]^{g[3\mapsto f]} \right)$$

$$= [\![\mathbf{purred}]\!]^{g[3\mapsto f]}([\![\mathbf{a}_3]\!]^{g[3\mapsto f]}([\![\mathbf{cat}]\!]^{g[3\mapsto f]}))$$

$$= [\![\mathbf{purred}]\!]^{g[3\mapsto f]}(f(\{\, x \mid [\![\mathbf{cat}]\!]^{g[3\mapsto f]}(x) = 1 \,\}))$$

$$= [\![\mathbf{purred}]\!]^{g[3\mapsto f]}(f(\{\, x \mid x \text{ is a cat} \,\}))$$

$$= 1$$

iff for some $f \in \mathsf{CF}$, $f(\{\, x \mid x \text{ is a cat} \,\})$ purred

iff at least one cat purred

One could implement this in a dynamic semantics but it is crucial that Existential Closure can apply at various scope sites.

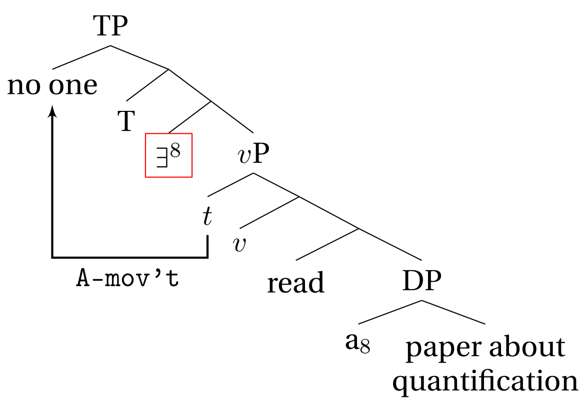
(8) No one read a paper about quantification.

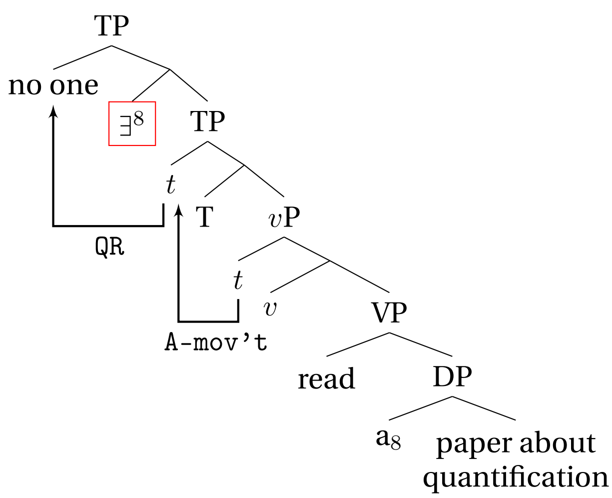
a. $\exists^8$ [no one read a_8 paper about quantification] (Wide scope)

b. No one $\exists^8$ [read a_8 paper about quantification] (Narrow scope)

Some don't assume such flexible Existential Closure (Kratzer 1998, Matthewson 1998), but that doesn't work, as we will discuss later.

The narrow scope reading could be derived in one of two ways (depends on your syntactic assumptions too).

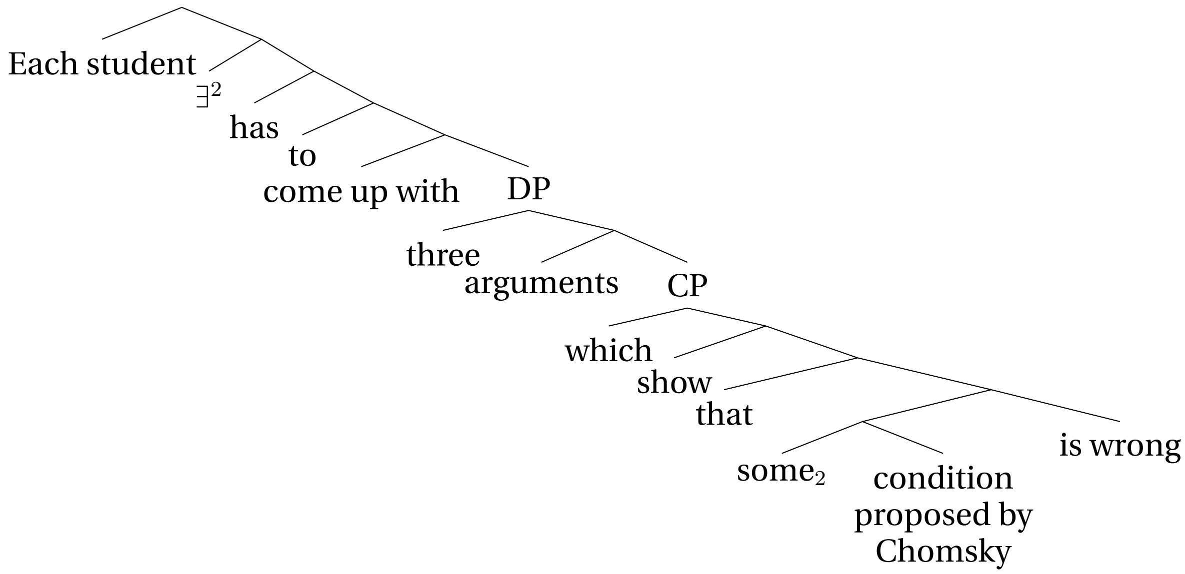




2 Intermediate scope readings

Both Reinhart 1997 and Winter 1997 derive intermediate scope readings with Existential Closure at intermediate scope positions.

(9) Each student has to come up with three arguments which show that some condition proposed by Chomsky is wrong. (Farkas 1981: p. 64)



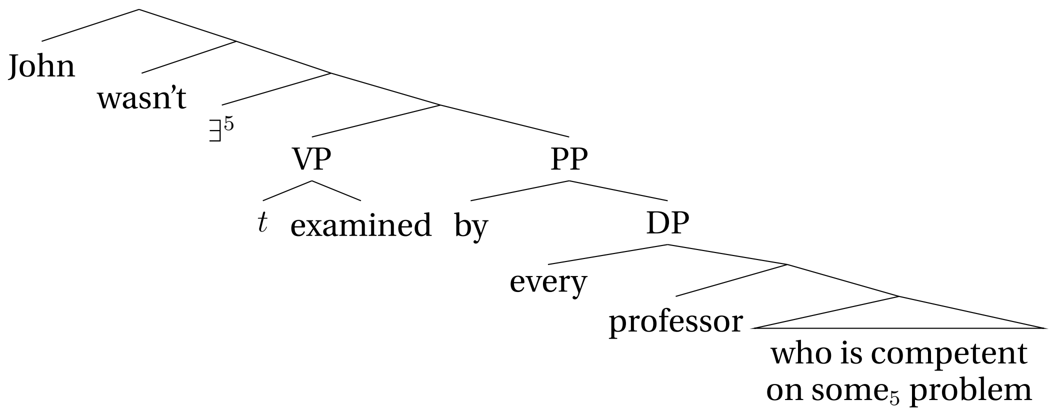
(10) (9) is true iff for each student x, there is $f \in \mathsf{CF}$ such that
x has to come up with three arguments which show that
$f(\{\, y \mid y$ is a condition Chomsky proposed $\})$ is wrong

The choice function denoted by the indefinite determiner picks out a particular individual out of the NP denotation, and that individual behaves scopeless with respect to the operators above it... until it hits the existential closure.

Choice functions can also deal with the examples that are problematic for Schwarzschild 2002 (see Lecture 1): Existential Closure can apply below negative operators, including negation.

(11) No boy ate all the cookies that a girl in his class brought.

(12) John wasn't examined by every professor who is competent on some problem. (Ruys & Spector 2017: p. 32)



(13) (12) is true iff there is no $f \in$ CF such that John was examined by every professor who is competent on $f(\{ x \mid x \text{ is a problem} \})$

3 Plurality

3.1 Ruys' observation

Ruys' observation follows under the choice functional analysis (Reinhart 1997, Winter 1997, 2001).

For indefinites with bare numerals, let us postulate an empty determiner denoting a choice function (not the only possible analysis). Bare numerals are modifiers.

(14) a. $[\![\varnothing_\xi]\!]^g = \lambda P_{\langle e,t\rangle}.\ g(\xi)(\{ x \mid P(x) = 1 \})$

b. $[\![\textbf{three}]\!]^g = \lambda P_{\langle e,t\rangle}.\lambda x_e.P(x) = 1$ and x has exactly three distinct atomic parts

c. $[\![\textbf{cities}]\!]^g = \lambda x_e.$ each atomic part of x is a city

(15) $\exists^1$ Every artist who was born in $\varnothing_1$ three cities became famous.

(16) $[\![(15)]\!]^g = 1$ iff there is $f \in$ CF such that every artist who was born in $f(\{ x \mid [\![\textbf{three cities}]\!]^g(x) = 1 \})$ became famous.

(NB: This is an *at-least* reading)

Reinhart 1997 says there's no reason why *three* cannot function as a determiner as well. For her, indefinites in general are ambiguous between choice functional indefinites and Generalised Quantifiers (GQs). Not so for Winter 1997.

The GQ denotation of *three* will look like (17). $\mathrm{sup}()$ is the supremum operator (with respect to the Linkian part-whole relation; Link 1983).

(17) $[\![\textbf{three}_{\textbf{GQ}}]\!]^g = \lambda P_{\langle e,t\rangle}.\lambda Q_{\langle e,t\rangle}.\ \mathrm{sup}(\{ x \mid P(x) = Q(x) = 1 \})$ has (exactly) three distinct atomic parts

NB: P and Q can be predicates of plurals, so we can't simply count the individuals that make P and Q true; we have to count the atomic individuals that are part of such individuals (Landman 1989). Here, it makes a difference whether to encode 'exactly' (= maximality operator) in the meaning (and we remain silent about it).

3.2 Modified numerals

Both Reinhart and Winter assume that modified numerals are always GQs. Then by assumption, they won't give rise to exceptional wide scope. Note that we do want maximality here (at least for upper bounded modified numerals; see Buccola & Spector 2016).

(18) $[\![\textbf{between 2 and 5}_{\textbf{GQ}}]\!]^g = \lambda P_{\langle e,t\rangle}.\lambda Q_{\langle e,t\rangle}.$ the (maximal) number of distinct atomic parts of $\sup(\{\, x \mid P(x) = Q(x) = 1 \,\})$ is between 2 and 5

However, given 'phantom readings' (Marty, Chemla & Spector 2015), we might want to have the same ambiguity for upper-bounded modified numerals: E.g.,

(19) Between 2 and 5 relatives of Mary's died.

If *between 2 and 5* can be a modifier, as in (20), and if (19) can be interpreted via a choice function, we'll get the truth-conditions in (21).

(20) $[\![\textbf{between 2 and 5}]\!]^g = \lambda P_{\langle e,t\rangle}.\lambda x_e.P(x) = 1$ and x has bewteen 2 and 5 distinct atomic parts

(21) $[\![(19)]\!]^g = 1$ iff there is $f \in \mathsf{CF}$ such that
$f(\{\, x \mid [\![\textbf{between 2 and 5 relatives of Mary's}]\!]^g(x) = 1 \,\})$ died.

This is also an *at least* reading (cf. Winter 1997: §3.5). For example, it will be true in a context where 10 relatives of Mary's died, because in such a context, we can use a choice function f that picks a group of, say, three relatives of Mary's that died, and make the sentence true.

Note that phantom readings don't require choice functions. A simple existential quantifier quantifying into an upper-bounded modified numeral also readings in an 'at-least' reading (van Benthem 1986: pp. 51–54).

No one tested exceptional wide scope phantom readings:

(22) a. Every artist who was born in between 2 and 5 cities became famous.
b. If between 2 and 5 relatives of Mary's die, she will inherit a fortune.

The truth-conditions predicted with wide-scope choice functions will be:

(23) a. $[\![(22a)]\!]^g = 1$ iff there is $f \in \mathsf{CF}$ such that
every artist who was born in $f(\{\, x \mid [\![\textbf{between 2 and 5 cities}]\!]^g(x) = 1 \,\})$ became famous.
b. $[\![(22b)]\!]^g = 1$ iff there is $f \in \mathsf{CF}$ such that
if $f(\{\, x \mid [\![\textbf{between 2 and 5 relatives of Mary's}]\!]^g(x) = 1 \,\})$ died, then Mary will inherit a fortune.

- (23a) is still about artists that were born in multiple cities, so should be #.
- (23b) has a sensible lower-bounded reading.

Note that since the distributivity is still trapped in the finite clause, this is orthogonal to the question as to why the following have wide scope distributive readings (for some speakers):

(24) If three relatives of Mary's die, she will inherit a fortune.

(25) If some relatives of mine invite me for dinner, I will panic.

(Geurts 2010: p. 134)

4 The empty set problem and Winter's modification

Winter 1997: §4.1 discusses the 'empty set problem': Technically, a choice function applied to $\varnothing$ returns an arbitrary individual.

(1) A function f from sets of individuals to individuals is a *choice function* if for each non-empty set S, $f(S) \in S$.

Consider:

(26) A circular square is obsessed with skateboarding.

The predicted truth-conditions are:

(27) (26) is true iff there is $f \in \mathsf{CF}$ such that $f(\varnothing)$ is obsessed with skateboarding.

Since there is a choice function that maps $\varnothing$ to Ruoying, the sentence is predicted to be true.
We don't want to say that a choice function indefinite presupposes that the NP denotation is non-null, as in (28).

(28) $[\![\mathbf{a}_\xi]\!]^g = \lambda P_{\langle e,t\rangle}\colon \exists x[P(x)=1].\, g(\xi)(\{\, x \mid P(x)=1 \,\})$

This will predict that (29) will be presupposition failure, rather than false (similarly for (26), but this example might be # for other reasons).

(29) This summer Mary read a romantic novel that Chomsky wrote.

Judgments about presupposition failure are sometimes not so straightforward (von Fintel 2004, Abrusán & Szendrői 2013; see also Geurts 2000 and Winter 2001: §3.4.3 for related discussion), but it seems that in this case there's a contrast with (30).

(30) This summer Mary read the romantic novel that Chomsky wrote.

Winter 1997: §4.1 proposes a modification of the definition of choice functions so that when a choice function is applied to $\varnothing$, it will yield the trivial GQ $\perp$:

(31) $\perp \coloneqq \lambda P_{\langle e,t\rangle}.\, 0$

(32) A function f from sets of individuals to individuals is a *choice function* if for each non-empty set S, $f(S) \in S$, <u>and $f(\varnothing) = \perp$</u>.

Winter 2001: §3.4.2 proposes a slightly different implementation of the same idea: He 'lifts' the choice function to a quantificational determiner that asserts that the NP is non-null.

(33) $[\![\mathbf{a}_\xi]\!]^g = \lambda P_{\langle e,t\rangle}.\lambda Q_{\langle e,t\rangle}.$ for some x, $P(x)=1$ and $Q(g(\xi)(\{\, y \mid P(y)=1 \,\}))=1$

5 Problems of the simple choice functional analysis

5.1 Problem 1: Overgeneration?

Recall that the original examples from Fodor & Sag 1982 don't seem to have intermediate scope readings.

(34) a. Each teacher overheard the rumor that a student of mine had been called before the dean.
b. Each teacher thinks that for a student I know to be called before the dean would be preposterous. (Fodor & Sag 1982: p. 374)

Existential closure under the top-most quantifier will yield the intermediate scope reading.

5.2 Problem 2: Bound pronouns

Recall that some examples of intermediate scope readings involve bound pronouns.

(35) Every professor rewarded every student who read a book he had recommended. (Abusch 1993: p. 90)

The intermediate scope reading of (35) can be dealt with with Existential Closure under *every* as well.

(36) $\left[\!\left[\begin{array}{l} \textbf{every professor}\ \lambda 8 \\ \quad \exists^3\ t_8\ \textbf{rewarded} \\ \qquad \textbf{every student who read a}_3\ \textbf{book he}_8\ \textbf{had recommended} \end{array} \right]\!\right]^g = 1$

iff for each professor x, there is $f \in$ CF such that x rewarded
every student who read $f(\{\, y \mid y$ is a book that x had recommended $\})$

Let us also consider what will happen if Existential Closure applies above *every professor*:

(37) $\left[\!\left[\begin{array}{l} \exists^3\ \textbf{every professor}\ \lambda 8 \\ \quad t_8\ \textbf{rewarded} \\ \qquad \textbf{every student who read a}_3\ \textbf{book he}_8\ \textbf{had recommended} \end{array} \right]\!\right]^g = 1$

iff there is $f \in$ CF such that for each professor x, x rewarded
every student who read $f(\{\, y \mid y$ is a book that x had recommended $\})$

- Suppose that different professors recommended different books. Then f will pick out a different book for different professors, so this is indistinguishable from the intermediate scope reading.
- But what if every professor recommended the same books? Then, f will return the same book for each professor. So it will look like a 'wide scope indefinite'. (Winter 1997: p. 444, Winter 2001: p. 115f, and Geurts 2000: §3 seem to assume that this reading doesn't exist; but I'm not so sure)
- What if some of the professors recommended the same books? Then f has to return the same book for all of them. This might not be a good result, but since

the intermediate scope reading is possible, it's hard to see if it's really problematic (Winter 2001: p. 115f makes a similar remark).

Schwarz 2001, 2011 points out that a clearer issue arises with non-upward monotonic quantifiers.

(38) No professor rewarded every student who read a book he had recommended.

Existential Closure below *no professor* will account for the intermediate scope reading.
But crucially, nothing prevents us from applying it above the negative quantifier.

(39) $\left[\!\left[\begin{array}{l} \exists^3 \textbf{ no professor } \lambda 8 \\ \quad t_8 \textbf{ rewarded} \\ \qquad \textbf{every student who read a}_3 \textbf{ book he}_8 \textbf{ had recommended} \end{array} \right]\!\right]^g = 1$ iff
there is $f \in$ CF such that for no professor x, x rewarded
every student who read $f(\{ y \mid y$ is a book that x had recommended $\}$

Suppose that different professors recommended different books. Then (39) can be verified by finding some way of choosing f such that for each professor, there is a book that they recommended such that they didn't reward every student who read it. In other words, it means (40).

(40) For no professor, every book that he recommended is such that he rewarded every students that read it.

This is not a possible reading of the sentence.
The same problem arises with a simpler example:

(41) No boy likes a relative of his.

When Existential Closure is applied above *no boy*, it will mean (42a), which is what (42b) expresses. Clearly (41) cannot mean that.

(42) a. There is $f \in$ CF such that no boy x likes $f(\{ y \mid y$ is a relative of x's $\})$.
b. No boy likes every relative of his.

Consider also:

(43) Exactly one candidate submitted a (single-authored) paper they wrote.

With Existential Closure above *exactly one candidate*, we get the following truth-conditions:

(44) There is $f \in$ CF such that
a candidate x submitted $f(\{ y \mid y$ is a paper x wrote $\})$ and
no other candidates z submitted $f(\{ y \mid y$ is a paper z wrote $\})$

This can be made true when every candidate submitted a paper they wrote, e.g.:

(45) a. Candidate A wrote papers p_{A1}, p_{A2}, p_{A3}, and submitted p_{A1} only.

b. Candidate B wrote papers p_{B1}, p_{B2}, and submitted p_{B1} only.
c. Candidate C wrote paper p_{C1}, and submitted p_{C1}.

Then there's a choice function that verifies (44), e.g.,

$$\begin{bmatrix} \{\, y \mid y \text{ is a paper that Candidate A wrote} \,\} \mapsto p_{A3} \\ \{\, y \mid y \text{ is a paper that Candidate B wrote} \,\} \mapsto p_{B2} \\ \{\, y \mid y \text{ is a paper that Candidate C wrote} \,\} \mapsto p_{C1} \\ \vdots \end{bmatrix}$$

So for sentences with non-upward monotonic quantifiers, we don't want Existential Closure to be able to apply above them.

To circumvent this overgeneration problem, Schwarz 2001 proposes a condition that prohibits relevant LFs (Schwarz 2011 calls this 'Condition A'):

(46) Integrity Condition: a choice function variable and its Existential Closure cannot be separated by an operator binding a variable in the indefinite.

5.3 Functional readings

However, Schwarz 2001 points out that this will undergenerate.

(47) No boy talked with a certain female relative of his about girls. (Schwarz 2001: p. 890)

This can be judged as true in a context where each boy didn't talked with his mother about girls but some of them did with their sisters, for example.

To obey the Integrity Condition, Existential Closure has to happen below *no boy* but that amounts to the narrow scope reading 'No body talked with any female relative of his about girls', which is false in the above scenario.

Furthermore, Existential Closure above *no boy* will yield a reading that is too weak and is paraphrasable by 'No body talked with every female relative of his about girls'. This reading doesn't seem to exist.

Rather, the wide scope reading of (47) amounts to a reading about *natural functions*, e.g., the function from the boys to their mothers, the function from the boys to their sisters, the function from the boys to their closest female relative, etc. (Endriss 2009; see Groenendijk & Stokhof 1984: p. 174f for functional answers to multiple *wh*-questions).

Schwarz 2001 points out that the function reading is unavailable with plain indefinites:

(48) No boy talked with a female relative of his about girls.

So perhaps we need to encode some meaning in *certain* such that it gives rise to a functional reading. But it seems that that will anyway violate the Integrity Condition, as long as we use choice functions.

5.4 Problem 3: Undergeneration

Schlenker 2006 discusses a reading that cannot be accounted for with simple choice functions.

(49) *Context: Every student in my syntax class has one weak point—John doesn't understand Case Theory, Mary has problems with Binding Theory, etc. Before the final I say:*

a. If each student makes progress in some area, nobody will flunk the exam.
b. If each student makes progress in a certain area, nobody will flunk the exam.
c. If each student makes progress in an area, nobody will flunk the exam.

(adapted from Schlenker 2006: p. 299)

- ($\exists >$ if $>$ every): This reading is about one particular area, so that's just false in the above scenario.
- (if $> \exists >$ every): This is still the same area for all the students, meaning 'If there is an area that all the students make progress in, nobody will flunk the exam', so it's false.
- (if $>$ every $> \exists$): This is now too strong, roughly meaning 'If everyone makes any type of progress, nobody will flunk the exam', and again false.

The true reading seems to be some thing like: For the function f that maps each student to the area they need to work on, if each studnet x makes progress in $f(x)$, nobody will flunk the exam. But we don't seem to have the variable x in (49).

You might be tempted to postulate an implicit restriction with a bound pronoun, e.g., *some area* is read as *some area that they are unfamiliar with* where *they* is bound by *each student* (similarly to 'paycheck pronouns'). Then we wouldn't need to refer to a function. However, if such a covert description is available, it should be available in (50) as well, but (50) cannot mean the same thing.

(50) If each student makes progress in at least one area, nobody will flunk the exam.

Chierchia 2001 and Schlenker 2006 conclude that we need *Skolemised choice functions* to derive the desired reading.

6 Intensionality

6.1 Intensionality and the Integrity Condition

Because the indefinite never leaves the scope island, it should be able to get a *de dicto*/opaque reading. Reinhart 1997, Winter 1997, and Geurts 2000 seem to think that this is a problem and that wide scope indefinites only get *de re*/transparent readings.

(51) Paul asked me whether a French student of mine has already graduated.

Suppose that I have an Italian student, who Paul wrongly thinks is French. He asked me whether she has already graduated (and he didn't ask me whether I have had a French student in the past). According to the above authors, (51) is false in such a scenario.

I'm not so sure about the judgment, but let's consider the predictions. We'll use a simpler example, so that we won't have to deal with question semantics.

(52) Paul denied that a French student of mine has already graduated.

(53) $[\![\textbf{denied}]\!]^{w,g} = \lambda p_{\langle s,t\rangle}.\lambda x_e.$
for every possible world w' compatible with what x said in w, $p(w') = 0$

Let's assume that everything is read *de dicto*/opaquely. With Existential Closure at the top-most position, we'll get the following truth-conditions:

(54) (52) is true with respect to w iff there is $f \in \mathsf{CF}$ such that
for every possible world w' compatible with what Paul said in w,
$f(\{\, x \mid x$ is a French student of mine in $w'\,\})$ has not graduated in w'

Crucially, in different worlds compatible with what Paul said, I could have different sets of French students (e.g, Paul didn't say anything about the identities of my French students), and in that case, f won't have to pick out the same student.

To be concrete, suppose:

(55) I have no French student but Paul said:
a. that I have three French students;
b. that one of them has graduated for sure;
c. that either one of the other two has graduated, but he doesn't know which (so couldn't say which).

The narrow scope reading (i.e., EC under *denied*) is falsified, due to (55b). But the truth-conditions in (54) will be true, because we can pick a choice function f that assigns each world compatible with what Paul said a French student of mine in that world that hasn't graduated yet. But intuitively, the sentence does not sound true.

In fact, the reading in question violates the Integrity Condition, with the modal *denied* being the quantifier and the intensional variable being the bound pronoun variable.

With the Integrity Condition, the only admissible LF is the one where the NP of the indefinite is read *de re*/transparent (however you achieve that).

(56) (52) is true with respect to w iff there is $f \in \mathsf{CF}$ such that
for every possible world w' compatible with what Paul said,
$f(\{\, x \mid x$ is a French student of mine in $w\,\})$ has not graduated in w'

6.2 Intensional choice functions

Reinhart 1997 proposes a different solution that uses intensional choice functions. The idea is to fix the world variable at the point of Existential Closure.

(57) An *intensional choice function* f maps (i) any possible world w and (ii) any

function s from possible worlds to sets of individuals to:

a. a member of $s(w)$ if $s(w)$ is not empty
b. $\perp$ if $s(w)$ is empty.

Let ICF be the set of all intensional choice functions.

(58) INTENSIONAL EXISTENTIAL CLOSURE: For any constituent ϕ of type t,

$$\left[\!\!\left[\begin{array}{c} \wedge \\ \exists^{\xi} \quad \phi \end{array} \right]\!\!\right]^{w,g} = 1 \text{ iff for some } f \in \mathsf{ICF}, [\![\phi]\!]^{w,g[\xi \mapsto f(w)]} = 1$$

(59) a. $[\![\mathbf{a}_{\xi}]\!]^{w,g} = \lambda P_{\langle s,\langle e,t\rangle\rangle}.\, g(\xi)(\lambda w'_s.\, \{\, x \mid P(w')(x) = 1\,\})$
b. $[\![\mathbf{cat}]\!]^{w,g} = \lambda x_e.\, x$ is a cat in w

(60) *Intensional Functional Application (without presupposition projection)*
If α is a branching node with β and γ as daughter constituents such that $[\![\beta]\!]^{w,g} \in D_{\langle\langle s,\sigma\rangle,\tau\rangle}$ and $\lambda w'.[\![\gamma]\!]^{w',g} \in D_{\langle s,\sigma\rangle}$, then $[\![\alpha]\!]^{w,g} = [\![\beta]\!]^{w,g}(\lambda w'.[\![\gamma]\!]^{w',g})$.
(cf. Heim & Kratzer 1998)

6.3 *De dicto*/opaque wide scope indefinites?

But both solutions will make wide scope indefinites always *de re*/transparent. Let's see if that's really a good prediction.

In (61), *certain* seems to give rise to a reading that violates the Integrity Condition (as before), and that seems to be compatible with the *de dico*/opaque reading of the NP. Is the *de dicto*/opaque reading also available without *certain*?

(61) Bill believes that there are unicorns in the forest near his house, and thinks that one of them has a golden mane and often comes to his garden, when people are not around.
a. Bill thinks that a (certain) unicorn that lives in the forest often comes to his garden.
b. Bill hopes that he will be friends with a (certain)/some unicorn that lives in the forest.
c. Bill asked me if a (certain)/some unicorn that lives in the forest is afraid of people.

(62) If some alumni of UCL are still doing semantics 10 years from now, I can say that this seminar was not useless.

7 Skolemised choice functions

7.1 Schlenker's reading and Skolemised choice functions

Recall Schlenker's 2006 observation:

(49) *Context: Every student in my syntax class has one weak point—John doesn't understand Case Theory, Mary has problems with Binding Theory, etc. Before the final I say:*
a. If each student makes progress in some area, nobody will flunk the exam.

b. If each student makes progress in a certain area, nobody will flunk the exam.
c. If each student makes progress in an area, nobody will flunk the exam. (adapted from Schlenker 2006: p. 299)

Chierchia 2001 and Schlenker 2006 claim that we need *Skolemised choice functions* here.

(63) A *Skolemised choice function* maps a sequence of individuals $x_1, \ldots x_n$ to a choice function.

We call the number n of individuals a Skolemised choice function takes its *arity*. Normal choice functions are Skolemised choice functions of arity 0.
With Existential Closure at the top-most level:

(64) (49) is true iff for a Skolemised choice function f of arity 1,
if each student x makes progress in $f(x)(\{ y \mid y$ is an area $\})$,
nobody will flunk the exam.

7.2 Intermediate scope readings

The intermediate scope reading of (9) can be derived with a wide scope Existential Closure with a Skolemised choice function.

(9) Each student has to come up with three arguments which show that some condition proposed by Chomsky is wrong. (Farkas 1981: p. 64)

(65) (9) is true iff there is a Skolemised choice function f of arity 1 such that
each student x has to come up with three arguments which show that
$f(x)(\{ y \mid y$ is a condition proposed by Chomsky $\})$ is wrong

For different values of x, $f(x)$ can be a different choice function, so this is what's been called the intermediate scope reading.
(See Chierchia 2001 for discussion of word-order effects, which he analyses as Weak Crossover effects and takes to be (indirect) evidence for the Skolemised choice functional analysis.)
Kratzer 1998 goes one step further: We no longer need to existentially close the variable; just leave it free, and pragmatics will resolve it, similarly to free pronouns. She argues that this is why we feel that wide scope indefinites sound like the speaker has some particular individual in mind.

7.3 Need for flexible Existential Closure

But Kratzer's 1998 idea undergenerates. Chierchia 2001 points out that there are cases of intermediate scope readings that cannot be accounted for with wide scope Skolemised choice functions (see also Schwarz 2001).

(66) Not every linguist studied every conceivable solution that some problem might have. (Chierchia 2001: p. 60)

(12) John wasn't examined by every professor who is competent on some prob-

lem. (Ruys & Spector 2017: p. 32)

This issue is analogous to the issue for Schwarzschild 2002 we discussed last weak: Because negation doesn't bind variables, the Skolemised choice function won't be dependent on it.

To derive the intermediate scope reading of the above examples, we need to be able to have Existential Closure under the negation.

(67) (12) is true iff it is not the case that
there is a Skolemised choice function of arity 0 such that
John was examined by
every professor who is competent on $f(\{\, y \mid y$ is a problem $\})$

See Chierchia 2001: §2.3 for similar issues arising from other kinds of embedding.

Therefore, we will assume a version of the Skolemised choice function theory that allows flexible Existential Closure.

7.4 Problem: indefinites in non-upward monotonic contexts

There is a big issue with Skolemised choice functions, however. Chierchia 2001 and Schwarz 2001 point out that unattested readings are predicted when indefinites occur in non-upward monotonic contexts.

(68) a. No student cited a paper about quantification.
b. Exactly one student cited a paper about quantification.
c. Every student who cited a paper about quantification was smart.

If the indefinite is interpreted as referring to a Skolemised choice function of arity 1 whose individual variable is bound by the subject quantifier, the predicted readings will be:

(69) (68a) is true iff for some Skolemised choice function f of arity 1,
there is no student x that cited $f(x)(\{\, y \mid y$ is a paper about quantification $\})$
$\approx$ No student cited every paper about quantification

(70) (68b) is true iff for some Skolemised choice function f of arity 1,
there is exactly one student x that cited $f(x)(\{\, y \mid y$ is a paper about quantification $\})$
$\approx$ At least one student cited a paper about quantification, and for each of the other students, there is a paper about quantification that they didn't cite.

(71) (68c) is true iff for some Skolemised choice function f of arity 1,
every student x that cited $f(x)(\{\, y \mid y$ is a paper about quantification $\})$ was smart.
$\approx$ Every student that cited every paper about quantification was smart.[1]

[1] This might not be obvious. Here's a way to think about it: For each student x who did *not* cite every paper about quantification, we can always make sure that the Skolemised choice function f maps x to a choice function that picks a paper about quantification that x didn't cite. Then this student will be outside the domain of quantification for *every*, so they won't matter for the truth-conditions. For every student that cited every paper about quantification, we have to make sure that they were smart.

This problem is reminiscent of the problem of bound pronouns for choice functions, but in this case there isn't even a need for actual bound pronouns. In a way, Skolemised choice functions of arity > 0 come with bound pronouns built in them.

But we can't have an LF constraint like the Integrity Condition, because we need binding for Schlenker's example (49)!

Relatedly, Winter 2001: p. 199 puts forward the *Matching Condition*:

(72) The arity of a Skolemised choice function corresponds to the number of pronouns free in the NP argument.

But this won't work for Schlenker's example (49) (see Chierchia 2001: p. 57 for a related remark).

7.5 Combining Schlenker and non-upward monotonic quantifiers

(73) If any student makes progress in some area, I will be happy.

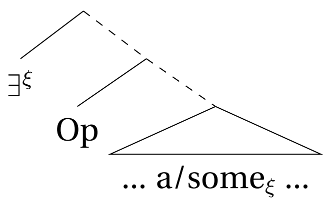
(74) a. If no student makes progress in some area, everybody will flunk the exam.
b. If no student makes progress in a certain area, everybody will flunk the exam.

(75) If every student but John makes progress in some area, he will be sad.

(76) If every student that has made progress in some area takes the exam, then the majority of students will pass.

8 Summary

- Schlenker's observation requires Skolemised choice functions.
- Intermediate scope readings under negation require flexible Existential Closure (contra Kratzer 1998, Matthewson 1998).
- Skolemised choice functions run into overgeneration issues with the configuration:



where Op creates a non-upward monotonic environment for the indefintie (with respect to the sister of $\exists^{\xi}$).

- Remaining mysteries
  - *Certain/specific/particular* and functional readings
  - Wide scope *de dicto*/opaque readings?

References

Abrusán, Márta & Kriszta Szendrői. 2013. Experimenting with the king of France: topics, verifiability and definite descriptions. *Semantics and Pragmatics* 6(10). 1–43. https://doi.org/http://dx.doi.org/10.3765/sp.6.10.

Abusch, Dorit. 1993. The scope of indefinites. *Natural Language Semantics* 2(2). 83–135. https://doi.org/10.1007/BF01250400.

van Benthem, Johan. 1986. *Essays in logical semantics*. Dordrecht: Reidel.

Buccola, Brian & Benjamin Spector. 2016. Modified numerals and maximality. *Linguistics and Philosophy* 39. 151–199. https://doi.org/0.1007/s10988-016-9187-2.

Charlow, Simon. 2020. The scope of alternatives: indefiniteness and islands. *Linguistics and Philosophy* 43. 427–472. https://doi.org/10.1007/s10988-019-09278-3.

Chierchia, Gennaro. 2001. A puzzle about indefinites. In Carlo Cecchetto, Gennaro Chierchia & Maria Teresa Guasti (eds.), *Semantic interfaces: reference, anaphora, and aspect*, 51–89. Stanford: CSLI.

Demirok, Ömer. 2019. *Scope theory revisited: lessons from pied-piping in* wh*-questions*. Massachusetts Institute of Technology dissertation.

Ebert, Cornelia. 2021. Wide scope indefinites. In Daniel Gutzmann, Lisa Matthewson, Cécile Meier, Hotze Rullmann & Thomas Ede Zimmermann (eds.), *The Wiley Blackwell companion to semantics*, 1–27. John Wiley & Sons, Inc. https://doi.org/10.1002/9781118788516.sem031.

Endriss, Cornelia. 2009. *Quantificational topics: A scopal treatment of exceptional wide scope phenomena*. New York: Springer.

Farkas, Donka. 1981. Quantifier scope and syntactic islands. In Roberta Hendrick, Carrie Masek & Mary F. Miller (eds.), *Proceedings of CLS 17*, 59–66.

von Fintel, Kai. 1998. Quantifiers and *if*-clauses. *The Philosophical Quarterly* 48. 209–214.

von Fintel, Kai. 2004. Would you believe it? The king of France is back! (Presuppositions and truth-value intuitions). In Marga Reimer & Anne Bezuidenhout (eds.), *Descriptions and beyond*, 315–341. Oxford: Oxford University Press.

Fodor, Janet Dean & Ivan A. Sag. 1982. Referential and quantificational indefinites. *Linguistics and Philosophy* 5(3). 355–398. https://doi.org/10.1007/BF00351459.

van Geenhoven, Veerle. 1998. *Semantic incorporation and indefinite descriptions: semantic and syntactic aspects of noun incorporation in West Greenlandic*. Stanford, CA: CSLI Publications.

Geurts, Bart. 2000. Indefinites and choice functions. *Linguistic Inquiry* 31(4). 731–738. https://doi.org/10.1162/002438900554550.

Geurts, Bart. 2010. Specific indefinites, presupposition, and scope. In Rainer Bäuerle, Uwe Reyle & Thomas Ede Zimmermann (eds.), *Presuppositions and discourse: essays offered to Hans Kamp*, 125–158. Emerald Group Publishing.

Groenendijk, Jeroen & Martin Stokhof. 1984. *Studies on the semantics of questions and the pragmatics of answers*. University of Amsterdam dissertation.

Heim, Irene. 1982. *The semantics of definite and indefinite noun phrases*. University of Massachusetts, Amherst dissertation.

Heim, Irene. 2011. Definiteness and indefiniteness. In Klaus von Heusinger, Claudia Maienborn & Paul Portner (eds.), *Semantics: an international handbook of natural language meaning*, vol. 2, 996–1025. Berlin: de Gruyter.

Heim, Irene & Angelika Kratzer. 1998. *Semantics in Generative Grammar*. Oxford: Blackwell.

Kratzer, Angelika. 1998. Scope or pseudo-scope? Are there wide-scope indefinites? In Susan Rothstein (ed.), *Events in grammar*, 163–196. Dordrecht: Kluwer.

Landman, Fred. 1989. Groups, I. *Linguistics and Philosophy* 12(5). 559–605.

Link, Godehard. 1983. The logical analysis of plurals and mass terms: A lattice theoretical approach. In Rainer Bäuerle, Christoph Schwarze & Arnim von Stechow (eds.), *Meaning, use, and the interpretation of language*, 302–323. Berlin: Mouton de Gruyter.

Marty, Paul, Emmanuel Chemla & Benjamin Spector. 2015. Phantom readings: the case of modified numerals. *Language, Cognition and Neuroscience* 30(4). 462–477. https://doi.org/10.1080/23273798.2014.931592.

Matthewson, Lisa. 1998. On the interpretation of wide-scope indefinites. *Natural Language Semantics* 7(1). 79–134. https://doi.org/10.1023/A:1008376601708.

Onea, Edgar. 2015. Why indefinites can escape scope islands. *Linguistics and Philosophy* 38. 237–267. https://doi.org/10.1007/s10988-015-9167-y.

Reinhart, Tanya. 1997. Quantifier scope: How labor is divided between QR and choice functions. *Linguistics and Philosophy* 20. 335–397. https://doi.org/10.1023/A:1005349801431.

Ruys, E. G. 2001. Wide scope indefinites: The genealogy of a mutant meme, or how Tanya Reinhart rendered an innocent observation difficult to understand, and how a generation of linguists managed to get it wrong. Ms, Universiteit Utrecht.

Ruys, Eddy G. & Benjamin Spector. 2017. Unexpected wide-scope phenomena. In *The Wiley Blackwell companion to syntax*, Second Edition. John Wiley & Sons. https://doi.org/10.1002/9781118358733.wbsyncom089.

Schlenker, Philippe. 2006. Scopal independence: a note on branching and wide scope readings of indefinites and disjunctions. *Journal of Semantics* 23(3). 281–314. https://doi.org/10.1093/jos/ffl005.

Schwarz, Bernhard. 2001. Two kinds of long-distance indefinites. In Robert van Rooy & Martin Stokhof (eds.), *Proceedings of Amsterdam Colloquium 13*, 192–197. Amsterdam: Universiteit Amsterdam.

Schwarz, Bernhard. 2011. Long distance indefinites and choice functions. *Language and Linguistics Compass* 5(12). 880–897. https://doi.org/10.1111/j.1749-818x.2011.00315.x.

Schwarzschild, Roger. 2002. Singleton indefinites. *Journal of Semantics* 19(3). 289–314. https://doi.org/10.1093/jos/19.3.289.

Winter, Yoad. 1997. Choice functions and the scopal semantics of indefinites. *Linguistics and Philosophy* 20. 399–467. https://doi.org/10.1023/A:1005354323136.

Winter, Yoad. 2001. *Flexibility principles in Boolean semantics: The interpretation of coordination, plurality, and scope in natural language*. Cambridge, MA: MIT Press.