Sinn und Bedeutung 24
Universität Osnabrück
Thursday 5 September 2019

DRAFT Rethinking scope islands

(and managing multidimensional meaning)

Chris Barker
New York University
Department of Linguistics

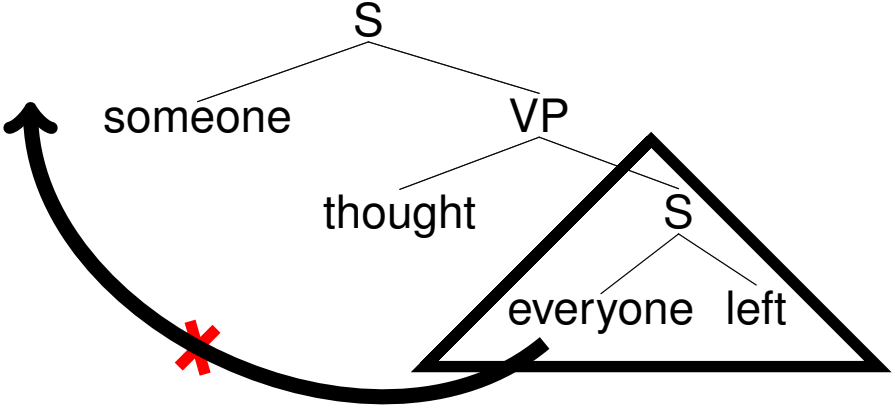
August 30, 2019
Slides and code at https://github.com/cb125/scope-islands

Scope islands

- A **SCOPE ISLAND** is a syntactic context that traps a scope-taker inside of it.

(1) Someone asked everyone to leave. [multiple askers: ok]

(2) Someone thought everyone left. [multiple thinkers: *]



What's at stake?

- Islands have intrisic theoretical interest
- Assuming that clauses are scope islands has driven major design decisions for the semantic analysis of
  - Focus
  - Questions
  - Indefinites
  - more...
- Today: clauses are *not* scope islands
- We must rethink scope islands empirically and theoretically
- A sufficiently flexible strategy for enforcing islands can help manage multi-dimensional meaning (focus, expressives, etc.)

Plan

- How did we get here?
  - Radford: relative clauses are islands
  - May: clauses are islands
- Data: clauses, tensed clauses, relative clauses: not islands
- Rethinking focus, questions, and indefinites as scope
- What scope islands are there?
- How can we build a general account of scope islands?

Marr: algorithmic level only today, sadly

Challenging the standard wisdom

Rodman 76: Relative clauses are scope islands

(3) John has dated a woman who loves every man. *$\forall > \exists$

(4) Guinevere has a bone that is in every corner of the house.

- p. 168: “In a relative clause the element that is relativized always has wider scope than any other element in that relative clause.”
- The same modification to Montague’s Quantifying In rule that makes relative clauses a scope island also makes them a syntactic island

(5) Barker 2015 *The Handbook of Contemporary Semantics*
“Relative clauses are particularly strong scope islands.”

Rodman. 1976. Scope phenomena,movement transformations, and relative clauses. Partee (ed) *Montague grammar* 165–176.

May 1977: clauses are scope islands

> p. 2: [I] propose a rule, QR, which generates representations at Logical Form for sentences containing quantifiers. Well-formedness of representations at this level is determined by universal principles on the output of the rules of core grammars; specifically, the Predication Condition, the Condition on Quantifier Binding and the Subjacency Condition are all argued to be general conditions on well-formed representations at Logical Form... [I]t follows from the Subjacency Condition that quantification is clause bounded, in the unmarked case.

Subjacency (roughly): movement cannot cross more than one bounding node (bounding nodes == S, DP).

(3.2) $[_{S_i}$ John hissed $[_{\bar{S}}$ that $[_{S_j}$ Smith liked $[_{NP}[_{Q}$ every painting$]]]]$

May 1977 *The Grammar of Quantification*. MIT Dissertation.

May's 1977:171 data that QR is clause bounded

(3.1)a Jones hissed that Smith liked every painting in the Metropolitan

b John quoted Bill as saying that someone had left

c His mother said loudly that everyone had to go

d Susan didn't forget that many people had refused to contribute

e Helen grieved that each of the monkeys had been experimented upon

f It is instructive for someone to play the piece first

g It's impossible for The Kid to fight a contender

h It's false that all the men left the party

i John asked whether he had bought some shuttlecocks at Abercrombie's

j Carol wondered why everyone was reading Gravity's Rainbow

k Mark regretted Sam's having invited so few people

The beautiful idea: scope islands == syntactic islands

> "Conceiving of Quantifier Raising as a syntactic rule provides a general explanation for some of the restrictions on quantifier scope... whatever principles of syntax rule out the formation of overt dependencies in these constructions can be tapped to rule out the creation of problematic covert dependencies at LF."

If only it were so—

- Farkas 1981 *CLS*: QR ignores syntactic islands
- Huang 1982 diss: in-situ wh scopes out of islands
  It's not Subjacency, it's the ECP
- Cecchetto 2003 *WCCFL*: phases are scope islands
- Wurmbrand 2017 ms.: it's processing difficulty

Dayal. 2012. The syntax of scope and quantification.
Cambridge Handbook of Generative Syntax

Relative Clauses are not scope islands

(6) May 1977:223
A book [which every prisoner left] surprised the warden.

(7) Sharvit 1999 *L&P*
The woman [that every man hugged] pinched him.

(8) Hulsey and Sauerland 2006, *NALS* **14**:131
"Relative clauses are not scope islands"
The picture of himself [that everyone sent in] annoyed the teacher.

(9) Szabolcsi 2010, CUP p. 107
$^{\gamma}$A timeline poster should list the different ages/periods (Triassic, Jurassic, etc.) and some of the dinosaurs or other animals/bacteria [that lived in each].

$^{\gamma}$ = naturally-occurring example (γ for Google).
Cf. also Hintikka's copular connectivity sentences

New data: relative clauses are not scope islands

(10) γThe data set represents the number of snails [that each person counted on a walk after a rainstorm]. 12, 13, 22, 16, 6, 10, 13, 14, 12

(11) γThe papers are all laid out by alphabetical order, so you can see the grade [that every person got].

(12) γWhat is the absolute earliest [that each character can die]?

(13) γGive the name [that corresponds to each abbreviation]: (a) GTP; (b) dCDP; (c) dTTP; (d) UDP.

(14) γClassroom time and content vary based on the job [that each person does].

(15) γFor the experiment, measure the time [that each person took to travel 20 meters].

(16) γInclude the name of the person [that each volunteer must report to].

Some quantifiers are in non-subject position.

So what explains Rodman's examples?

(17) John has dated **a woman** who loves every man.

(18) Guinevere has **a bone** that is in every corner of the house.

- Indefinite head nouns make it harder
- Pragmatic manipulations can help
- *Each* is a stronger island-escaper

(19) [As part of the usual painstaking security clearance background investigation,]
FBI agents tracked down and interviewed a woman who had dated each man.

- In any case, all that matters today is whether there are *any* quantifiers that scope out of relative clauses

More research needed

(Tensed) clauses are not scope islands

(20) Fox and Sauerland 1995 *NELS 26*
In general, a guide ensures that [every tour to the Louvre is fun].

(21) Farkas and Giannakidou 1996 *SALT 6*
A student made sure that [every invited speaker had a ride].

(22) Szabolcsi 2010 *CUP* p. 107
Determine whether [each number in the list is even or odd].

"distributive scope is not always clause-bounded: *each NP* supplies solid counterexamples"

- And of course, in all of the relative clause examples given above the crucial universal is also within a tensed clause!

New data: clauses are not scope islands: *before* and *after*

(23) Someone needs to clean the room after each guest has left.

(24) γ After [each person had been taken], we heard a shot—one for each.

(25) γ After [each person had eaten], they had a spot of kunkumam (colored powder) placed on their foreheads.

(26) γ Henceforth you will see a draw method call after [each object is created]

(27) γ [B]efore [each person had a turn doing the DB thrusters], that person had to do a farmer's carry of 40 meters

(28) γ After [each person had a turn of leading the horse, they were given a debrief on their communication style which ranged from bored, quiet, ...

(29) γ after [each person had written down his opinion on an issue] he was handed back a slip of paper presumably containing a tabulation of the opinions in the group

New data: universals are not clause-bounded: *when*

(30) γ When [each person had finished his turn at shoveling], he placed the spade back into what remained of the mound.

(31) γ When [each person finishes], thank them for sharing. Take a few seconds to pause in silence before the next person shares.

(32) γ When [each person finishes filling out the form], they should place it back on a table and remain or leave the space.

(33) γ When [each person finishes speaking], they pass the football to someone else.

New data: clauses are not scope islands: *unless*

(34) γ Unless [each person thinks that the others will cooperate], he himself will not.

(35) γ Unless [each person communicates their needs], the other family members aren't likely to help them satisfy ...

New data: clauses are not scope islands: *make sure/ensure*

(36) A student made sure that [every invited speaker had a ride] == Farkas and Giannakidou's (21) above

(37) $^{\gamma}$But someone has to make sure that [each actor has what is needed at the time it is needed].

(38) $^{\gamma}$On a global scale, someone has to make sure that [each application, when introduced, doesn't send ... shock waves through the economy].

(39) $^{\gamma}$Someone needs to make sure that [each incoming report or complaint of abuse is actually being investigated].

(40) $^{\gamma}$Someone should ensure that [each tool has been returned to its proper storage location]...

(41) $^{\gamma}$Once the responsibilities are clarified, someone should make sure that [each group is doing what it is supposed to do].

So what explains May's examples?

- Set aside untensed clauses in (f) and (g)
- Set aside wh complements (i), (j) and the DP in (k)
- In (a) through (e) and (h), all communication verbs or attitude verbs: *hissed*, *quoted*, *said*, *forget*, *grieved*, *be false*
- Possible alternative hypotheses: the complement of attitude verbs is a scope island for *every* and *each*
- Note that *make sure* is a rare sentence-embedding verb that is not a verb of communication, nor is it an attitude verb—and as Farkas and Giannakidou realize, and as the previous slide shows, easily allows universals embedded in its complement to scope out
- In any case, all that matters today is whether there are *any* universals that scope out of a tensed clause.

So why should the complements of attitude verbs be islands?

What we've learned so far

- Universal quantifiers systematically scope out of clauses, tensed causes, and relative clauses
- So clauses (taken as a class) are not scope islands
- Whether a universal can scope out of a clause depends on the embedding predicate: *thought*, no, but *make sure*, yes.
- So scope islands are created on a per-predicate basis.

What's at stake: the "exceptional scope" conspiracy

Defending the standard wisdom: "Exceptional" Scope

"Exceptional" scope: If the standard wisdom were right, and Quantifier Raising were clause bounded, then whenever a scope-taker appears to take scope outside of an island, it must be via some mechansim other than QR.

- Indefinites: choice functions, Skolem functions, singleton sets, alternatives with pointwise functional application, etc.
- Focus: alternative sets
- Pair-list readings of universals inside embedded questions
- Functional relative clauses

The "Exceptional Scope" Conspiracy: At the end of the day, non-QR scoping mechansims deliver the same truth conditions that QR would deliver if we ignored islands.

Interesting test case: functional indefinites

Ordinary indefinites can take arbitrarily wide scope

(42) Nobody believes the rumour that a student of mine cheated.

(43) Each student read every paper that discussed a particular problem.

- each $>$ every $>$ a [overachieving student]
- each $>$ a $>$ every [specialist student]
- a $>$ each $>$ every [departmental monoculture]

(44) Schwarz 2001 Amsterdam Colloquium

"Indefinites can often be interpreted as if they had scoped from a syntactic island."

Fodor and Sag 1982, Farkas 1981, Abusch 1994, Kratzer/Reinhart 1998, Chierchia 2001, Schwarz 2001, Schlenker 2006, ...

Explaining the wide scope of indefinites

- Abusch 1994 *NALs*: the reason that indefinites behave differently than distributive predicates is because indefinites are not quantificational (as in Heim's 1982 dissertation)
- Different behavior, therefore different mechanism
- Yes, but it's choice functions (Kratzer/Reinhart/Winter 1998)
- Yes, but it's singleton indefinites (Schwartzschild 2002)
- Yes, but it's alternatives with pointwise function composition
  - Charlow 2018 *Linguistics & Philosophy*
  - Universals, indefinites all clause-bounded (!)
  - But clauses can take scope ("roll-up", "snowballing")
- In each case, the net result is equivalent to allowing indefinites to take scope via Quantifier Raising
- So Quantifier Raising is perfectly adequate for interpreting indefinites, if we have a way of managing scope islands

Functional indefinites

- Winter, Schwarz, Schlenker, Solomon, Bumford

(45) If every student improves in a (certain) area, no one will fail.
$\exists \mathrm{f}.\textbf{if}(\forall \mathrm{x}.\textbf{improves}(\mathrm{x})(\mathrm{f}(\mathrm{x})(\textbf{area})))(\textbf{no-fail})$

- not equivalent to any configuration of *if*, $\forall$, $\exists$
- Skolemized choice function will work: $\mathrm{f} :: \mathrm{e} \rightarrow (\mathrm{e} \rightarrow \mathrm{t}) \rightarrow \mathrm{e}$
- Non-QR mechanisms for indefinties aren't any better suited at managing choice functions than Quantifier Raising is
- Bumford 2015 *Semantics & Pragmatics*
  - functional reading only arise near universals, e.g., *every*
  - independently-motivated sequence-forming *every*: *Every year I buy a faster car*
  - indefinites have their ordinary simple existential meaning

Compositional focus

- Rooth's 1985 diss. builds focus meanings compositionally
- alternative sets, composed via pointwise composition

- Why not via Quantifier Raising? Rooth 85 gives two arguments:
  - Scope is clause-bounded (standard wisdom)
  - Multiple foci just work (*Ann only introduced BILL to SUE*)

- But scope is not clause-bounded!
- Multiple foci easy to handle via scope (Krifka 92, Rooth 96)
- Quantifier Raising works great for computing focus sets!

- BTW, indefinites do not have completely unrestricted scope

  (46) Ann only gave a book to BILL. [*$\exists >$ *only*]

- The complement of *only* is a scope island for indefinites

Details in fragment below

Functional Relative Clauses

(47) The woman who hugged every man pinched him.

- Sharvit 1999 *L&P*: "If Scoping (Quantifier Raising or "quantifying in") is clause-bounded, as is often argued, it cannot be the mechanism responsible for these readings."

- Proposes a special-purpose relativization operator

$$[\text{Op QNP}] \rightarrow \lambda K \lambda P \lambda T \lambda R \exists A[W([\text{QNP}], A) \;\&\; \forall x \in A[R(T(\lambda g[\text{Dom}(g) = A \;\&\; \forall y \in A[P(g(y)) \;\&\; K(g, y)]])(x), x)]]$$

- Delivers truth conditions as if the universal had wide scope

Scope islands and weak Negative Polarity Items

- What else should we expect from a theory of scope islands?
- Weak NPIs must occur in a suitable licensing context
- In addition, must take scope inside the licening context

(48) If [a relative of mine dies], I'll inherit a house. [ambiguous]

(49) If [**any** relative of mine dies], I'll inherit a house. [unambig]

- But requiring scope inside a licensor is not enough—
  it must be the *closest* potential licensor:

(50) Ann doubts Bill didn't see anyone. [*doubt $>$ $\exists$ $>$ not]

Generalization: licensing contexts are scope islands for NPIs

What we've learned so far

- Clauses are not scope islands
- Scope islands are created on a per-predicate basis
- Scope islands trap some scope-takers but not others: universals escape from fewer islands than indefinites do
- So: whether a scope-taker is trapped in a context depends both on the specific predicate that created the contex, and on the identity of the scope-taker in question

An algorithmic description

Formal accounts of scope islands

- Montague grammar: Rodman 1976
  - Not clear how to generalize to other island phenomena
- Type Logical Grammar: Moortgat and associates
  - Kurtonina, Hepple, Morrill, Bernardi, Kokke, others:
  - Per-predicate islands easy, per-scoper sensitivity harder
  - Kokke's per-scoper solution related to the proposal below
  - Bernardi and Szabolcsi 2008, see below
- Continuation Hierarchy: Kiselyov & Shan 2014 (see below)
- Today's proposal: argument indexing
  - Quantifier Raising as a general scoping mechanism
  - Fine-grained lexical control over islands and scopers
  - Simple, explicit, precise, and implemented

Kiselyov & Shan's 2014 Continuation Hierarchy

Syntax	Semantic type	Denotation $[\![\cdot]\!]$
VP $\rightarrow$ Vs that S	et^n or $((et)^n \rightarrow \{\alpha\}) \rightarrow \{\beta\}$	$[\![\text{Vs}]\!]^{>}([\![\text{S}]\!])_2$
NP $\rightarrow$ that S	e^n or $(e^n \rightarrow \{\alpha\}) \rightarrow \{\beta\}$	$\mathbf{That}\,.\,([\![\text{S}]\!])_2$
NP $\rightarrow$ NP_1 and NP_2	e^n or $(e^n \rightarrow \{\alpha\}) \rightarrow \{\beta\}$	$\mathbf{alongWith}\,.\,[\![\text{NP}_1]\!]\,.\,[\![\text{NP}_2]\!]$
N $\rightarrow$ max	e	$\mathbf{max}$
N $\rightarrow$ lady	et	$\mathbf{lady}$
Det $\rightarrow$ some_3, a_3	$(et) \rightarrow (e^{n+1} \rightarrow \{\beta_3(n+1)\gamma\}) \rightarrow \{\beta_3 n\gamma\}$	$\lambda z.\uparrow [\![\text{some}_2]\!]\, z$
Det $\rightarrow$ some_4, a_4	$(et) \rightarrow (e^{n+1} \rightarrow \{\beta_4(n+1)\gamma\}) \rightarrow \{\beta_4 n\gamma\}$	$\lambda z.\uparrow [\![\text{some}_3]\!]\, z$

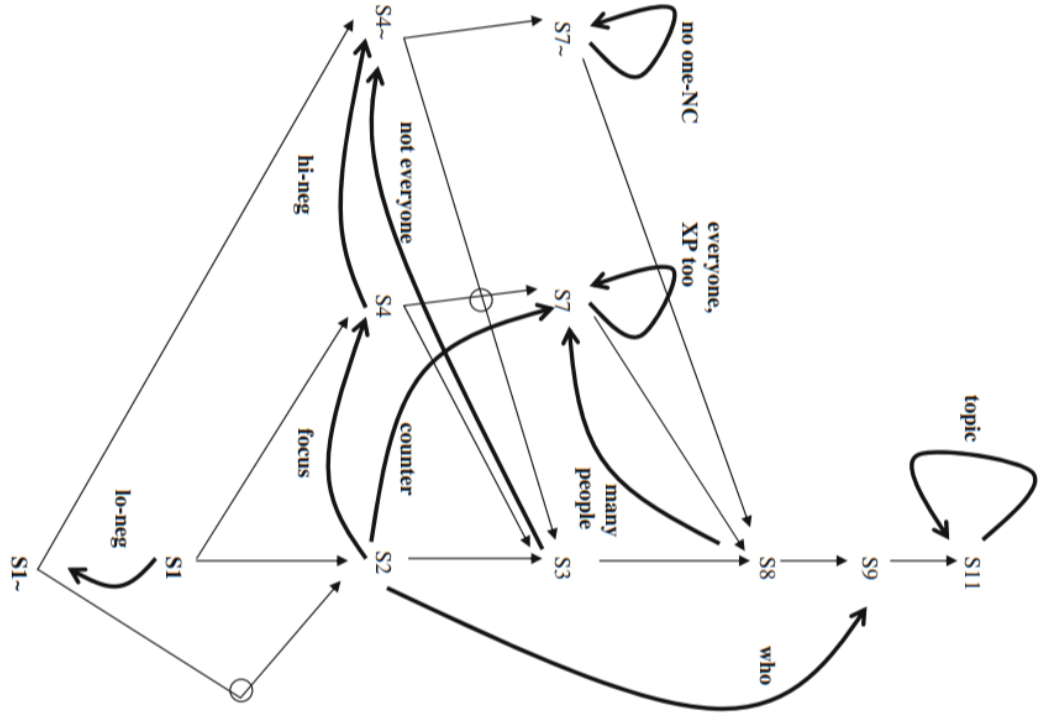
Fig. 13. Adjustments to the syntax and the multi-level direct-style continuation semantics for the additional fragment, to account for wide-scope indefinites. If the size of the sequence γ is j, the size of β_3 is $3(j+2)$ and of β_4 is $7(j+2)$.

- Excellent theoretical and computational properties
- Fine-grained control: per-predicate, per-scoper

Comparison with Kiselyov & Shan 2014

- Similarities with the account here (spiritual siblings!): continuation-based, directly compositional, per-predicate/per-scoper flexibility, islands and scopers correspond to integer strength levels
- Conceptual differences: for K&S, quantifier scope ambiguity is due to polysemy in the scope takers, instead of being purely syntactic, as here
- Practical limitations of the K&S system (as they present it): only clauses can be islands, scope takers must take scope only over clauses, the result type must be a clause, no parasitic scope, weaker scope takers must be uniformly weaker with respect to all islands
- Practical advantages of argument indexing: the familiarity of Quantifier Raising, more expressive flexibility, super easy to verify a derivation by hand

Bernardi and Szabolcsi: scope-takers in Hungarian



Light lines: derivability; dark lines: lexical operators
B&S assume a separate clause-bounded scoping mechanism

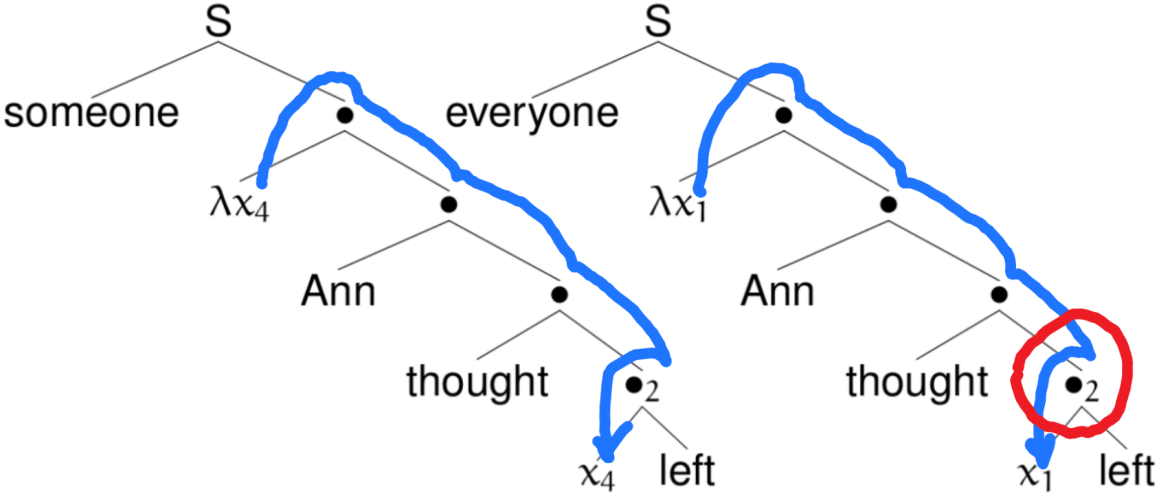
Proposal: flavors of syntactic combination

- Informed by Kokke 2016, but without unary modalities (see also Barker and Shan 2014:221 *CUP*)
- For each functional type, choose a specific flavor of syntactic combination
- Example: the complement of *thought* is an island for *everyone*, but not for *someone*
- Complement of *thought* is a strength-2 island: $\langle \mathtt{t}, \langle \mathtt{e}, \mathtt{t} \rangle \rangle^2$
- Trace of *someone* is a strength-4 island escaper: $\langle \langle \mathtt{e}, \mathtt{t} \rangle^4, \mathtt{t} \rangle$
- Trace of *everyone* is a strength-1 island escaper: $\langle \langle \mathtt{e}, \mathtt{t} \rangle^1, \mathtt{t} \rangle$
- If the path between a quantifier and its trace crosses a node with an equal or higher index, that's an island violation.
- Bigger == stronger: stronger island, stronger island-escaper

Kokke 2016. *NLQ: a modular type-logical grammar for quantifier movement, scope islands, and more.* Utrecht MS thesis

Illustration

Follow the chain from each lambda to its trace:

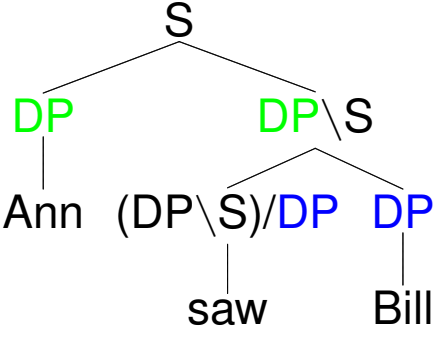


think assigns its complement to mode 2
everyone provides its trace with island-hopping strength of just 1

$\mathbf{NL}_{\mathrm{QR}}$: Non-associative Lambek with Quantifier Raising

$$\frac{\Gamma \vdash A \quad \Sigma[B] \vdash C}{\Sigma[\Gamma \cdot A\backslash B] \vdash C}\backslash L \qquad \frac{A \cdot \Gamma \vdash B}{\Gamma \vdash A\backslash B}\backslash R \qquad \frac{}{A \vdash A}\,\text{Axiom}$$

$$\frac{\Gamma \vdash A \quad \Sigma[B] \vdash C}{\Sigma[B/A \cdot \Gamma] \vdash C}/L \qquad \frac{\Gamma \cdot A \vdash B}{\Gamma \vdash B/A}/R \qquad \Sigma[\Delta] \equiv_{\mathrm{QR}} \Delta \cdot \lambda\alpha\Sigma[\alpha]$$

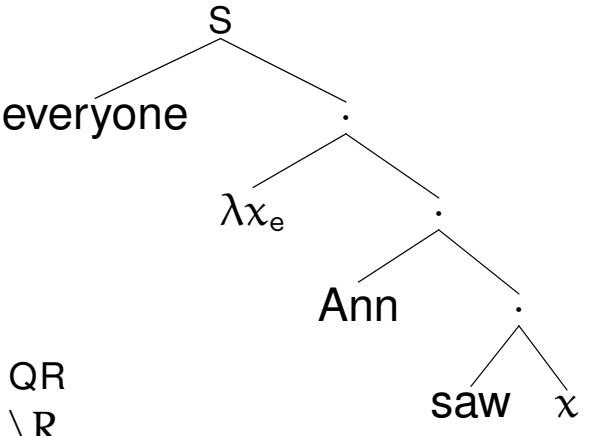


$$\dfrac{\mathrm{DP} \vdash \mathrm{DP} \qquad \dfrac{\mathrm{DP} \vdash \mathrm{DP} \quad \mathrm{S} \vdash \mathrm{S}}{\mathrm{DP} \bullet \mathrm{DP}\backslash\mathrm{S} \vdash \mathrm{S}}\backslash L}{\mathrm{DP} \bullet ((\mathrm{DP}\backslash\mathrm{S})/\mathrm{DP} \bullet \mathrm{DP}) \vdash \mathrm{S}}/L$$

Lambek's 1958, 1961 non-associative, sequent presentation
Barker 2007, Barker and Shan 2014, Barker 2018: decidable

Simple example of Quantifier Raising

(51) Ann saw everyone.

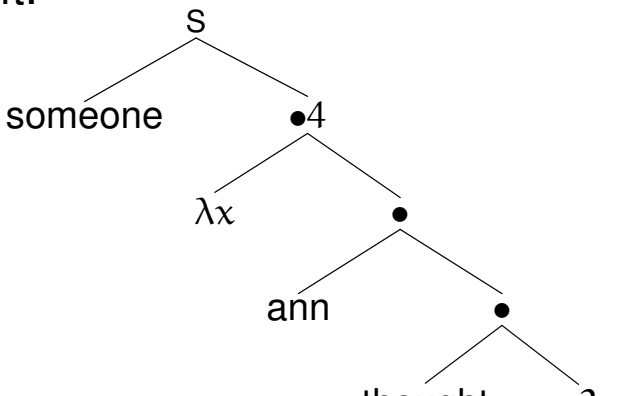


$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{}{\mathrm{DP} \vdash \mathrm{DP}} \quad \dfrac{}{\mathrm{S} \vdash \mathrm{S}}}{\mathrm{DP} \bullet \mathrm{DP}\backslash\mathrm{S} \vdash \mathrm{S}}\backslash\mathrm{L}}{\mathrm{DP} \bullet ((\mathrm{DP}\backslash\mathrm{S})/\mathrm{DP} \bullet \mathrm{DP}) \vdash \mathrm{S}}/\mathrm{L}}{\mathrm{DP} \bullet \lambda x(\mathrm{DP} \bullet ((\mathrm{DP}\backslash\mathrm{S})/\mathrm{DP} \bullet x)) \vdash \mathrm{S}}\mathrm{QR}}{\lambda x(\mathrm{DP} \bullet ((\mathrm{DP}\backslash\mathrm{S})/\mathrm{DP} \bullet x)) \vdash \mathrm{DP}\backslash\mathrm{S}}\backslash\mathrm{R} \quad \dfrac{}{\mathrm{S} \vdash \mathrm{S}}}{\mathrm{S}/(\mathrm{DP}\backslash\mathrm{S}) \bullet \lambda x(\mathrm{DP} \bullet ((\mathrm{DP}\backslash\mathrm{S})/\mathrm{DP} \bullet x)) \vdash \mathrm{S}}/\mathrm{L}}{\mathrm{DP} \bullet ((\mathrm{DP}\backslash\mathrm{S})/\mathrm{DP} \bullet \mathrm{S}/(\mathrm{DP}\backslash\mathrm{S})) \vdash \mathrm{S}}\mathrm{QR}$$

The logic guarantees that the QR derivation type-checks

Some technical details: successful derviation

(52) Ann thought someone left.

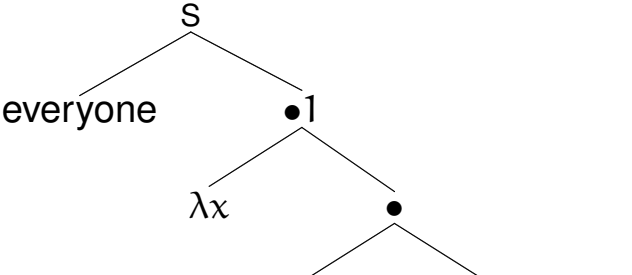


$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\vdots}{\mathrm{DP} \bullet ((\mathrm{DP}\backslash \mathrm{S})/_2 \mathrm{S} \bullet_2 (\mathrm{DP} \bullet \mathrm{DP}\backslash \mathrm{S})) \vdash \mathrm{S}}}{\mathrm{DP} \bullet_4 \lambda x(\mathrm{DP} \bullet ((\mathrm{DP}\backslash \mathrm{S})/_2 \mathrm{S} \bullet_2 (x \bullet \mathrm{DP}\backslash \mathrm{S}))) \vdash \mathrm{S}}\,\mathrm{QR}}{\lambda x(\mathrm{DP} \bullet ((\mathrm{DP}\backslash \mathrm{S})/_2 \mathrm{S} \bullet_2 (x \bullet \mathrm{DP}\backslash \mathrm{S}))) \vdash \mathrm{DP}\backslash_4 \mathrm{S}}\,\backslash\mathrm{R} \qquad \mathrm{S} \vdash \mathrm{S}}{\mathrm{S}/(\mathrm{DP}\backslash_4 \mathrm{S}) \bullet \lambda x(\mathrm{DP} \bullet ((\mathrm{DP}\backslash \mathrm{S})/_2 \mathrm{S} \bullet_2 (x \bullet \mathrm{DP}\backslash \mathrm{S}))) \vdash \mathrm{S}}\,/\mathrm{L}}{\mathrm{DP} \bullet ((\mathrm{DP}\backslash \mathrm{S})/_2 \mathrm{S} \bullet_2 (\mathrm{S}/(\mathrm{DP}\backslash_4 \mathrm{S}) \bullet \mathrm{DP}\backslash \mathrm{S})) \vdash \mathrm{S}}\,\mathrm{QR}}{\mathrm{Ann} \bullet (\mathrm{thought} \bullet (\mathrm{someone} \bullet \mathrm{left})) \vdash \mathrm{S}}$$

Crucial inference: top QR: trace_4 crosses $\bullet, \bullet_2, \bullet$. $4 > 2$, ok.

Some technical details: failed derviation

(53) Ann thought everyone left.



$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\vdots}{\mathrm{DP} \bullet ((\mathrm{DP}\backslash \mathrm{S})/_2 \mathrm{S} \bullet_2 (\mathrm{DP} \bullet \mathrm{DP}\backslash \mathrm{S})) \vdash \mathrm{S}}\,\mathrm{QR}}{\mathrm{DP}\bullet_1 \lambda x(\mathrm{DP}\bullet((\mathrm{DP}\backslash \mathrm{S})/_2 \mathrm{S}\bullet_2(x\bullet \mathrm{DP}\backslash \mathrm{S}))) \vdash \mathrm{S}}\backslash \mathrm{R}}{\lambda x(\mathrm{DP} \bullet ((\mathrm{DP}\backslash \mathrm{S})/_2 \mathrm{S} \bullet_2 (x \bullet \mathrm{DP}\backslash \mathrm{S}))) \vdash \mathrm{DP}\backslash_1 \mathrm{S}} \qquad \mathrm{S} \vdash \mathrm{S}\,/\mathrm{L}}{\mathrm{S}/(\mathrm{DP}\backslash_1 \mathrm{S}) \bullet \lambda x(\mathrm{DP} \bullet ((\mathrm{DP}\backslash \mathrm{S})/_2 \mathrm{S} \bullet_2 (x \bullet \mathrm{DP}\backslash \mathrm{S}))) \vdash \mathrm{S}}\,\mathrm{QR}}{\mathrm{DP} \bullet ((\mathrm{DP}\backslash \mathrm{S})/_2 \mathrm{S} \bullet_2 (\mathrm{S}/(\mathrm{DP}\backslash_1 \mathrm{S}) \bullet \mathrm{DP}\backslash \mathrm{S})) \vdash \mathrm{S}}$$

$$\mathrm{Ann} \bullet (\mathrm{thought} \bullet (\mathrm{someone} \bullet \mathrm{left})) \vdash \mathrm{S}$$

Crucial inference: top QR: trace_1 crosses $\bullet, \bullet_2, \bullet$. $1 \not> 2$, not ok.

$\mathbf{NL_{QR}}$, combinator implementation, with scope islands

- Multiple modes, indexed by integers: $\backslash_1$ $\bullet_1$ $/_1$, $\backslash_2$ $\bullet_2$ $/_2$...
- Each mode corresponds to a different flavor of island
- I, B, C: zero-ary structural logical connectives (combinators)
- p, q, r schematize over arbitrary structures; i, j over ints
- These structural inference rules replace QR with local hops:

$$\frac{p}{p \bullet_i I}\ \mathsf{I} \qquad \frac{(p \bullet_j q) \bullet_i r}{p \bullet_j (q \bullet_i (r \bullet_0 B))}\ \mathsf{B} \qquad \frac{p \bullet_i (q \bullet_j r)}{q \bullet_j (p \bullet_i (r \bullet_0 C))}\ \mathsf{C}$$

- Condition for enforcing scope islands: $j > i$
- If $j \not> i$, then mode i is an island wrt mode j
- Given a set of indexes, the grammar will contain every instantiation of these inferences that satisfies the condition

"Modes of syntactic combination", not the usual linguistic modals

The crucial inferences using combinators

(54) Ann thought someone left. [ok: $\exists > \text{thought}$]

Strength 4 trace DP successfully climbs out of a strength 2 island:

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\mathrm{DP}\bullet((\mathrm{DP}\backslash \mathrm{S})/_2\mathrm{S}\bullet_2(\mathrm{DP}\bullet\mathrm{DP}\backslash\mathrm{S}))\vdash \mathrm{S}}{\mathrm{DP}\bullet((\mathrm{DP}\backslash \mathrm{S})/_2\mathrm{S}\bullet_2((\mathrm{DP}\bullet_4\mathrm{I})\bullet\mathrm{DP}\backslash\mathrm{S}))\vdash \mathrm{S}}\,\mathrm{I}}{\mathrm{DP}\bullet((\mathrm{DP}\backslash \mathrm{S})/_2\mathrm{S}\bullet_2(\mathrm{DP}\bullet_4(\mathrm{I}\bullet(\mathrm{DP}\backslash\mathrm{S}\bullet \mathrm{B}))))\vdash \mathrm{S}}\,\mathrm{B}}{\mathrm{DP}\bullet(\mathrm{DP}\bullet_4((\mathrm{DP}\backslash \mathrm{S})/_2\mathrm{S}\bullet_2((\mathrm{I}\bullet(\mathrm{DP}\backslash\mathrm{S}\bullet \mathrm{B}))\bullet \mathrm{C})))\vdash \mathrm{S}}\,\mathrm{C}}{\mathrm{DP}\bullet_4(\mathrm{DP}\bullet((\mathrm{DP}\backslash \mathrm{S})/_2\mathrm{S}\bullet_2((\mathrm{I}\bullet(\mathrm{DP}\backslash\mathrm{S}\bullet \mathrm{B}))\bullet \mathrm{C}))\bullet \mathrm{C})\vdash \mathrm{S}}\,\mathrm{C}$$

(55) Ann thought everyone left. [$^*\forall > \text{thought}$]

Strength 1 trace DP fails to climb out of a strength 2 island:

$$\dfrac{\dfrac{\mathrm{DP}\bullet((\mathrm{DP}\backslash \mathrm{S})/_2\mathrm{S}\bullet_2(\mathrm{DP}\bullet\mathrm{DP}\backslash\mathrm{S}))\vdash \mathrm{S}}{\mathrm{DP}\bullet((\mathrm{DP}\backslash \mathrm{S})/_2\mathrm{S}\bullet_2((\mathrm{DP}\bullet_1\mathrm{I})\bullet\mathrm{DP}\backslash\mathrm{S}))\vdash \mathrm{S}}\,\mathrm{I}}{\mathrm{DP}\bullet((\mathrm{DP}\backslash \mathrm{S})/_2\mathrm{S}\bullet_2(\mathrm{DP}\bullet_1(\mathrm{I}\bullet(\mathrm{DP}\backslash\mathrm{S}\bullet \mathrm{B}))))\vdash \mathrm{S}}\,\mathrm{B}$$

Since $1 \not> 2$, there is no instance of the C inference that would allow the trace to escape the complement of *thought*

Enlarging the fragment a bit

Strength	Island		Scoper	
6			damn	$\mathsf{T}/((\mathsf{N}/\mathsf{N})\backslash_6\mathsf{S})$
5	only	$(\mathsf{DP}\backslash\mathsf{S})/_5\mathsf{F}$	FOCUS	$(\mathsf{F}/(\mathsf{DP}\backslash_5(\mathsf{DP}\backslash\mathsf{S})))/\mathsf{DP}$
4			someone	$\mathsf{S}/(\mathsf{DP}\backslash_4\mathsf{S})$
3	if	$(\mathsf{S}/\mathsf{S})/_3\mathsf{S}$	anyone	$\mathsf{S}/(\mathsf{DP}\backslash_3\mathsf{S})$
2	thought	$(\mathsf{DP}\backslash\mathsf{S})/_2\mathsf{S}$		
1			everyone	$\mathsf{S}/(\mathsf{DP}\backslash_1\mathsf{S})$

Some other lexical items:

ann, bill, carl: DP left: $\mathsf{DP}\backslash\mathsf{S}$ the: DP/N dog: DP

Example analyses

The antecedent of a conditional is a scope island for weak NPIs, but not for ordinary indefinites:

```
if anyone left, ann left:

  ((if (anyone left)) (left ann))


if someone left, ann left:

  ((if (someone left)) (left ann))

  (someone (\x ((if (left x)) (left ann))))
```

Runable code available at `github.com/cb125/scope-islands`

Weak NPIs such as *anyone* can escape a *thought* complement, but not the antedent of a conditional.

```
if ann thought anyone left, bill left:
  ((if ((thought (anyone (\x (left x)))) ann))
       (left bill))**
  ((if (anyone (\x ((thought (left x)) ann))))
       (left bill))
```

An ordinary indefinite can escape both:

```
if ann thought someone left, bill left:
  ((if ((thought (someone (\x (left x)))) ann))
       (left bill))
  ((if (someone (\x ((thought (left x)) ann))))
       (left bill))
  (someone (\x ((if ((thought (left x)) ann))
                    (left bill))))
```

**NPI licensing not implemented here; see Barker 2018 *L&P*

The complement of *only* traps even indefinites:

```
Ann only thought someone saw FOC Carl:
((only ((foc carl)
        (\x (\y ((thought (someone (\z ((saw x) z))))
                 y)))))
 ann)
```

But nothing traps an expressive like *damn*:

```
Ann only thought the damn dog saw FOC Carl:
(damn (\f ((only ((foc carl)
                  (\x (\y ((thought ((saw x)
                                     (the (f dog))))
                           y)))))
           ann)))
```

Towards a theory of multidimensional meaning

What dimensions of meaning can and should be included?

- Nominal quantifiers
- NPIs
- focus
- expressives

- interrogatives and in-situ wh
- appositives
- *same* and *different*
- comparatives (Nouwen and Dotlačil 2017 *S& P*)
- adverbial quantifiers, modals
- negation
- DE quantifiers (*Few people know 3 languages*: *$3 >$ few)
- negative concord (Kuhn 2019 SALT)
- linear bias
- crossover and weak crossover
- inverse linking and DPs in general
- ...?

Are island strengths ordered?

- Indefinites can escape the antecedent of a conditional, but universals cannot.
- Can there ever be a context in which a universal can escape, but not an indefinite?

(56) I know who everyone likes. [pair list reading ok: $\forall > \mathrm{Q}$]

(57) I know who someone likes. [choice reading: *?$\exists > \mathrm{Q}$]

- It's easy to model this using the combinator grammar: just add structural rules allowing a universal to escape from the flavor of island that characterizes an interrogative context.
- But it raises the possibility that the full picture will require arbitrary relations among argument indexes

Towards a more explanatory theory

- I have concentrated today on When and How:
  - When is a scoper trapped? (Not inside a clause!)
  - How can we enforce scope islands? (Argument indexing)
- What about Why?
- Indefinites take wide scope *because of their meaning*
  - How: indefinite alternatives ignore QR
- Licensing contexts are scope islands for NPIs *because that's the point of getting licensed*??
- Universals (unlike indefinites) can scope over questions *because (only) conjoining speech acts makes sense*
- In other cases, the answer is much less clear:
  - Why is *realize* but not *make sure* an island for *everyone*?
  - Why do DE operators resist undergoing inverse scope?

We're in the business of answering the Why question. But first we have to get the empirical picture right, and then we have to have a way of describing the patterns we find explicitly and precisely.

Conclusions

- Despite long-established standard wisdom, neither clauses, tensed clauses, nor relative clauses are scope islands.
- Therefore decisions motivated by the belief that scope is clause-bounded need to be rethought
- If Quantifier Raising can deliver appropriate denotations, QR should be the presumptive scoping mechanism

- We have only a hazy idea what the empirical landscape of scope constraints looks like (current gold standard: Szabolcsi 2010).
- Scope islands are per-predicate and per-scope taker
- Argument indexing provides a simple and practical fine-graine tool for describing scope islands.
- Argument indexing can help manage multiple dimensions of meaning

THANKS!!

Special thanks to Dylan Bumford, Simon Charlow, Rueben Cohn-Gordon, Svetlana Godjevac, Wen Kokke, Elisa Kreiss, Jeremy Kuhn, Michèle Lowrie, Anna Szabolcsi, and audiences in Dubrovni and Stanford.