Dissecting Quantifiers
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SCILLS 2013
http://scills.btk.ppke.hu/

Lectures 1 and 2
Three classes of quantifier phrases
Lecture 3
Towards compositionality in quantifier words
Lectures 4 and 5
What do quantifier particles do?

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Lectures 1 and 2
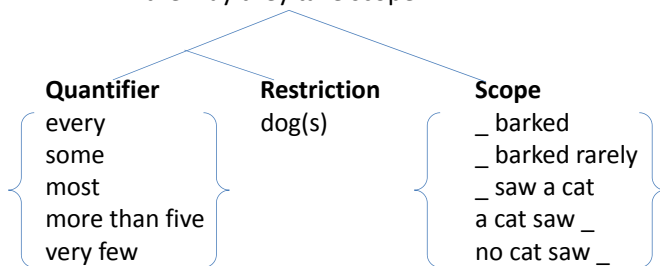**Three classes of quantifier phrases**

The classical view
All quantifier phrases are equal
in their internal structure and
in the way they take scope.

Montague 1974, Barwise & Cooper 1981, May 1985, Heim & Kratzer 1998, and many others

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The classical view

All quantifier phrases are equal
in their internal structure and
in the way they take scope.

Quantifier	**Restriction**	**Scope**
every	dog(s)	_ barked
some		_ barked rarely
most		_ saw a cat
more than five		a cat saw _
very few		no cat saw _

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Scope assignment

The Quantifier Phrase + Scope structure may be the original constituent structure, or it may be created by Quantifier Raising (QR) or by some other operation, adjunction or feature checking.
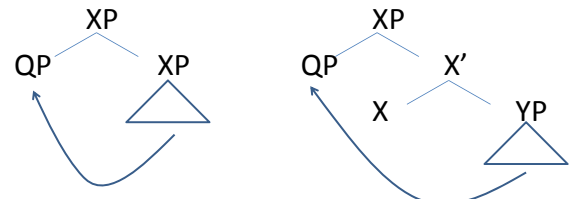
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Quantifier phrases denote Generalized Quantifiers	Scopes denote properties
λP[every-dog'(P)]	λx[saw-a-cat'(x)]
	λx[a-cat-saw'(x)]
`the set of properties that every dog has'	`the property of seeing a cat / being seen by a cat'

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Predictions of the classical view

Re: internal structure
When two quantifiers have the same denotation, differences in their internal structures do not matter.

Re: scope taking
All QPs have the same ability to scope over any other QP or operator, and over the same syntactic domains (with the possible exception where the result is incoherent gibberish)

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Are these predictions correct?

Scope taking is not uniform (old observations)

I can't believe the rumor that he bribed two judges.
- ✓ `for two particular judges, I can't believe the rumor that he bribed them'

I can't believe the rumor that he bribed every judge.
- # `for every judge, I can't believe the rumor that he bribed him/her'

More than one girl saw every film.
- ✓ `for every film, more than one girl saw it'

Every girl saw more than one film.
- # `there is more than one film that every girl saw'

Are these predictions correct?

Internal structure matters (more recent observations)
- *At least two men left* IFF *More than one man left*
    - ✓ At least two doctors shook hands.
    - # More than one doctor shook hands.
- *At most four men left* IFF *Fewer than five men left*
    - *Beryl had three sherries.*
    - OK $\Rightarrow$ Beryl had fewer than five sherries.
    - NO $\Rightarrow$ Beryl had at most four sherries.
- *Most of the men left* IFF *More than 50% of the men left*
    - # The kids read most of the books each.
    - ✓ The kids read more than 50% of the books each.

What emerges: Three classes of "quantifier phrases"

	Formal tools
1 Bare (numeral) indefinites 2 Distributive universals	
both have two kinds of scope:	**choice functions**
unbounded existential scope	**Skolemization**
clause-bounded distributive scope	**Dist, δ operators**
3 Counting quantifiers (aka modified numerals)	
clause-bounded, intervention-sensitive split scope	**degree quanti- fication**

Discussion will be based on

Indefinites and universals

Ruys 1992, Reinhart 1997, Beghelli & Stowell 1997, Szabolcsi 1997, Farkas 1997, Lin 1998, Kratzer 1998, Matthewson 1999, Stanley & Szabo 2000, Chierchia 2003, Schlenker 2006

Counting quantifiers

Sutton 1993, Cresti 1995, Beghelli & Stowell 1997, Szabolcsi 1997, Heim 2001, Hackl 2000, 2009, Szabolcsi 2006, Geurts & Nouwen 2007, Takahashi 2006

See Chapters 6 to 11 of Quantification (Szabolcsi 2010) for comprehensive discussion.

Class 1 Bare (numeral) indefinites
Seem to have unbounded, island-free scope

I can't believe [the rumor [that he bribed two judges]].
- ✓ `for two particular judges, I can't believe the rumor that he bribed them'

Each student has to hunt down [every paper which shows [that a certain claim by Chomsky is wrong]].
- ✓ `each student > a certain claim > every paper'
- ✓ `a certain claim > each student > every paper'

[If some lady dies], Bill inherits a house.
- ✓ `for some lady, if she dies, Bill inherits a house'

Bare (numeral) indefinites
But do they have island-free scope?

A student has to hunt down [every paper which shows [that certain claims by Chomsky are wrong]].
- ✓ `for certain claims, a student has to hunt down...'
- BUT students cannot vary with claims

[If two ladies die], Bill inherits a house.
- ✓ `for two particular ladies, if they die...'
- BUT only one house in total can be inherited

COMPARE	Two ladies left Bill a house.
	✓ `two houses in total'

A contradiction!

The findings cannot be described using the classical scope vocabulary.

The first set of data shows that indefinites can be referentially independent of quantifiers and negation that c-command them outside islands => they have unbounded scope.

The second set shows that plural indefinites cannot induce variation in other, clause-external indefinites => they have clause-internal scope.

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Solution

Distinguish two kinds of scope for indefinites.

"**Existential scope**," which pertains to referential independence. Unbounded.

> Formal tool: choice function variable, existentially closed from a distance, or contextually given

"**Distributive scope**," which pertains to the ability to induce variation in others. Clause-bounded.

> Formal tool: silent distributive operator on the predicate (a universal quantifier, δ operator)

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Choice functions cf

A choice function cf looks at every set and chooses an element of that set. **dog(cf(dog)) always true**

cf_1(dog)= Fido	cf_2(dog)=Spot	...
cf_1(cat)=Max	cf_2(cat)=Tiger	...
cf_1(city)=Paris	cf_2(city)=LA	...
cf_1(two-dogs)= {Fido, Spot}	cf_2(two-dogs)= {King, Spot}	...
...	...	...

also with sets whose elements are not individuals:
two-dogs' = { {Fido, Spot}, {King, Spot}, {Spike,King}, {Fido,King}, {Fido,Spike}, {Spike,Spot} }

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Uses of choice functions

Since the value of cf(dog) is an individual dog, cf(dog) in the place of an individual expression is well-formed:

> hungry'(fido')   hungry'(cf(dog'))

$\exists$cf[hungry'(cf(dog'))]   iff $\exists$x[dog'(x) $\wedge$ hungry'(x)]
`there is a choice function such that the individual it chooses from the set of dogs is hungry'

hungry'(cf(dog'))   iff   dog'(x) $\wedge$ hungry'(x)
`the individual that the contextually relevant choice function chooses from the set of dogs is hungry'

Similarly for pluralities or sets, cf(two-dogs').

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Using cfs avoids the unbounded QR of indefinites.
Two possible analyses of maximal scope

If two ladies die, Bill inherits a house.

$\exists$**cf** [**cf**(two-ladies) die $\rightarrow$ Bill inherits a house]

`there is a choice function cf such that if the pair that cf chooses from the set of pairs of ladies dies, Bill inherits a house'

(**cf**(two-ladies) die) $\rightarrow$ Bill inherits a house

`if the pair that the contextually relevant cf chooses from the set of pairs of ladies dies, Bill inherits a house'

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"Distributive scope" of indefinites

Two ladies EACH left him a house.

$\exists$cf [cf(two-ladies') δ(left-him-a-house)']

If α is a plurality and β is a property, [α δ(β)] is true iff $\forall$x[atom(x, α) $\rightarrow$ β(x)].

The δ operator (Link 1983), like adverbial *each*, is adjoined to the predicate, not to NP, and is thus unaffected by the extra-clausal existential scoping of the plural indefinite.

If two ladies EACH die, Bill inherits a house.

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A new way of creating dependencies: Skolemization

Every number is smaller than its successor.

$\forall n\ \exists m$ [imm. succeed(m, n) $\land$ n < m]

$\forall n$ [n < <u>successor(n)</u>]

A Skolem function has zero, one, or more parameters (individual arguments) that can make it dependent on quantifiers it is in the scope of. In mathematics, Skolem functions are used to rid formulae of existential quantifiers.

A Skolem function need not also be a choice function (see above), but it can be.

Two possible analyses of clause-external but dependent readings

Each student hunts down [every paper which shows [that a certain claim is wrong]].

✓ `each student > a certain claim > every paper'

- with intermediate $\exists$-closure of cf:

$\forall x$[student'(x)$\rightarrow$ $\exists$**cf**$\forall y$[paper'(y) $\land$ show'(y, wrong'(**cf**(claim'))) $\rightarrow$ hunt-down'(x, y)]]

- with Skolemized contextual choice function, cf(x):

$\forall x$[student'(x)$\rightarrow$ $\forall y$[paper'(y) $\land$ show'(y, wrong'(**cf(x)**(claim'))) $\rightarrow$ hunt-down'(x, y)]]

Two distinct dependent readings

If every student improves in a particularly difficult area, the teacher will be happy.

Maximal-scope, independent reading:

the same area for everyone (say, calculus)

Dependent reading #1:

every student must improve in some difficult area or other, no matter which area

Dependent reading #2 with strict co-variation:

every student must improve specifically in the difficult area he/she has the most problems with

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Here $\exists$-closure vs. Skolemization make a truth-conditional difference

Dependent reading #1:

($\forall x\ \exists cf$[improve'(x, in cf(area'))]) $\rightarrow$ happy'(the-tchr')

Dependent reading #2:

($\forall x$ [improve'(x, in <u>cf(x)</u>(area'))]) $\rightarrow$ happy'(the-tchr')

The Skolemized choice function <u>cf(x)</u> selects, for any x, the area that x has the most problems with.

The same function can select different areas from the set of areas, depending on which x it is working for.

Are indefinites all alike?

Ability to take clause-external scope:

certain NP > two NP, some NP > a(n) NP

Adding a relative clause or PP often helps.

(A) certain NP is the typical item for contextually given and potentially Skolemized indefinites.

Note: Counting quantifiers or modified numerals (*at least/at most two NP, more/less than two NP, more NP1 than NP2, two or more NP*, etc.) are not considered under the rubric "indefinite".

Are universals all alike?
each vs. *every* vs. *all the*

Some tourist or other thought that ... sight(s) was/were boring.
Can tourists vary with sights?
each: yes   *every*: no   *all the*: no

Some tourist or other visited ... sight(s).
Can tourists vary with sights?
each: yes   *every*: yes   *all the*: no

... tourist(s) lifted up the van.
Can the tourists have acted collectively?
each: no   *every*: no   *all the*: yes

[although: ✓ *It took every tourist to lift up the van.*]

Focus on *every NP*-type universals

E*very NP* is distributive,
easily takes clause-internal inverse scope,
but doesn't take extra-clausal scope.

Preliminary conclusion:

Every NP only has distributive scope, which is clause-internal. The distributive operator is probably part of *every NP* though, not a VP-adverb, unlike with plural indefinites.

Is this conclusion correct?

Unbounded existential scope for universals?

You cannot list every prime number.
⇒There is a set, the one containing all primes, such that you cannot list every element of it.

I don't believe that you listed every prime number.
⇒There is a set, the one containing all primes, such that I don't believe that you listed every element of it.

If every prime number is divisible by 1, then …
⇒There is a set, the one containing all primes, such that if every element of it is divisible by 1, then …

Domain restriction and co-variation

Context: There are 3 empty vinegar bottles and 4 full wine bottles in the cupboard. We need vinegar. I look in the cupboard and report,
Every bottle is empty.
Can this be true? Not every bottle in the world, not even every bottle in the cupboard is empty!

Context: "Syntax" is a course that every student must complete at some point. Head of department notices,
Every "Syntax" teacher failed every first-year student.
Can this be true? Did they all teach all the first-years?

Parallelism with indefinites

The prime numbers examples show that sentences with universals entail the maximal-scope existence of the (non-empty) restrictor set. (*Every NP* is a principal filter.)

The bottles example shows that the restrictor set of *every* can be further delimited by context.

The first-years example shows that the restrictor sets can co-vary with a c-commanding quantifier.

The powerset of set S is the set of all subsets of S.

cf(powerset(bottle')) = a contextually relevant subset of the set of bottles

cf(x)(powerset(first-year')) = contextually relevant subsets of the set of first-years, chosen in variation with a quantifier that binds the Skolem parameter x.

Interim summary

Potentially unbounded existential scope and tensed-clause bounded distributive scope are distinguished for both indefinites and *every NP*-type universals.

two books ♦ cf(two-books')
             or skolemized cf(x)(two-books')
         ♦ cf is ∃-closed or contextually given
         ♦ distributivity via δ(predicate); δ = ∀

every book ♦ cf(powerset(book'))
             or skolemized cf(x)(powerset(book'))
         ♦ cf unambiguously given in context
         ♦ moves to Spec,DistP; Dist = ∀

Why is dual scope news?

Traditional examples inspired by predicate logic:
Every student read *a book*.
Not discovered or not investigated:
Two students read a book.
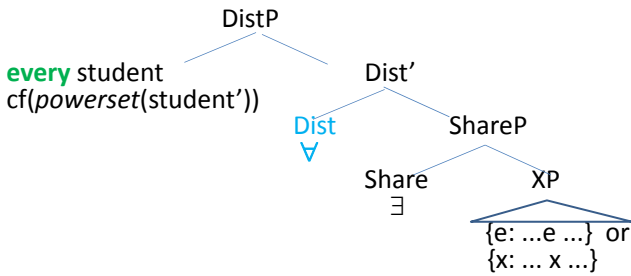*Every prof failed* **every first-year student**.

In the traditional examples, *every man* can induce variation but itself does not exhibit variation;
a book can vary but itself does not induce variation.
"What is the scope of QP?" was a different question in each case.
For *every man*, "What is its distributive scope?"
For *a book*, "What is its existential scope?"

Class 2 *Every NP*

contributes a subset of NP, but not distributivity
compare **mei-ge xuesheng dou** VP (Lin 1996, 1998)

```
                    DistP
             ┌────────┴────────┐
every student              Dist'
cf(powerset(student'))  ┌────┴────────┐
                      Dist          ShareP
                       ∀        ┌─────┴─────┐
                             Share          XP
                               ∃       ┌─────┴─────┐
                                      {e: ...e ...}  or
                                      {x: ... x ...}
```

Every signals the association of *every student* with **Dist**, like negative concord markers do with the real negation.

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How do *some students'* and *every student'* differ?

The cupboard has 3 empty vinegar bottles and 4 full wine bottles.

(i) *Every bottle is empty.*

(ii) *Some bottles are empty.*

Both can be true here.

(i) requires a cf that is unambiguous in the context: the cf variable is deictic.

(ii) asserts that there exists a contextually relevant cf: the cf variable is ∃-closed.

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Class 3 Counting quantifiers

Unlike indefinites and *every NP*-type universals, counters do not take existential scope outside their own clause.
Some tourist or other thought that more than ten sights were boring.
there are more than ten sights which ...

Counters do not take inverse scope over the subject (at most, they take inverse scope over another counter in subject).
- *Every girl read more than ten books.*
  # there are more than ten books read by every girl
- Some girl or other read more than ten books.
  # girls vary with books
- *At least one girl read more than ten books.*
  ? girls vary with books

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Counters consist of a numerical and an individual quantifier that can "split"

How many patients must Dr. X visit?
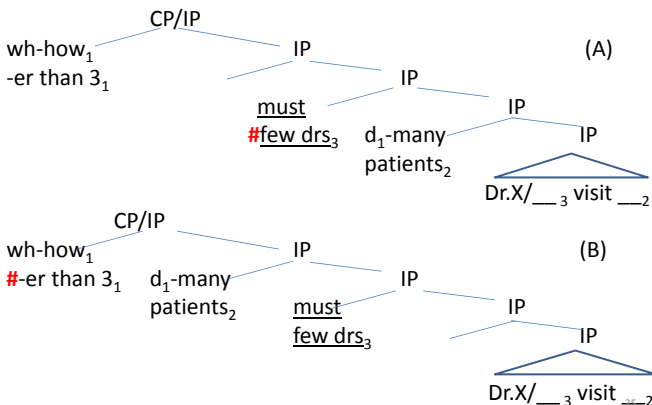✓`For what number n, there are n patients whom Dr. X <u>must</u> visit?'   (individual reading)
✓ `For what number n, it <u>must</u> be that there are n patients whom Dr. X visits?' (cardinal reading)

How many patients did few doctors visit?
✓`For what number n, there are n patients whom <u>few doctors</u> visited?' (individual reading)
For what number n, for <u>few doctors</u> are there n patients whom they visited?' (cardinal reading)

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wh-how/-er than 3 ... d-many NP intervention (A) and inverse scope (B)

```
            CP/IP
      ┌───────┴───────┐
wh-how₁               IP                        (A)
-er than 3₁      ┌────┴────┐
                          IP
                      ┌───┴────┐
                   must        IP
                  #few drs₃  ┌──┴────┐
                         d₁-many      IP
                         patients₂  ┌──┴──┐
                                         IP
                                    Dr.X/___₃ visit ___₂
```

```
        CP/IP
   ┌──────┴──────┐
wh-how₁          IP                             (B)
#-er than 3₁  ┌──┴────────┐
          d₁-many          IP
          patients₂   ┌────┴────┐
                   must          IP
                  few drs₃    ┌───┴──┐
                                    IP
                             Dr.X/___₃ visit ___₂
```

Degree comparison
d is a variable over degrees, D over degree intervals

More than three people smile.

```
         ┌────┐    λd
         │    │  ┌──┴──┐
      ┌──┴──┐ │  │  ┌──┴──┐
```

-er   than 3   d-MANY   people   smile

d-MANY people   λP. ∃x[people'(x) ∧ |x|≥d ∧ P(x)]
-er   λD.λD'[max(D') > max(D)]
[than] 3   λd.d=3
max(λd.∃x[people'(x) ∧ smile'(x) ∧|x|≥d]) > max(λd.d=3)
iff   ∃x[people'(x) ∧ smile'(x) ∧ |x|>3]

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Degree operator ... intervener ... restriction

✓ Modal or intensional operator scopally intervenes between the degree operator and its restriction *d-many/much NP* (but see Lassiter, SALT 22).

✓ Name or non-distributively interpreted plural (in)definite intervenes.

Every NP, few NP, only XP, or *negation* scopally intervenes (Honcoop 1998, Kennedy 1999, Pesetsky 2000, Heim 2001, Hackl 2000, Beck 2006).

Caveat: Sometimes a quantifier linearly intervenes, but does not scope, between the degree operator and its restriction, e.g. ✓ pair-list reading. (Szabolcsi & Zwarts 1993).

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Inverse scope: over subject vs. over another VP-internal quantifier

Every student read more than one paper.
more than one NP > every NP

John submitted more than one paper to every journal.
✓ more than one NP > every NP

John submitted every paper to more than one journal.
✓ more than one NP > every NP

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Account in terms of split and intervention (Takahashi 2006)

a. The decomposition of *more than n NP* into *-er than n* and *d-many NP*.

b. QR forced by type mismatches, subject to Shortest Move.

c. Optional Quantifier Lowering, subject to Shortest Move.

d. Shortest: QR/QL targets the closest node of type t.

e. VP-internal XPs are equidistant from vP of type t.

f. Intervention constraint: A quantificational DP cannot intervene between DegP and its trace in *d-many NP*.

g. Scope Economy: Covert QR/QL cannot be semantically vacuous.
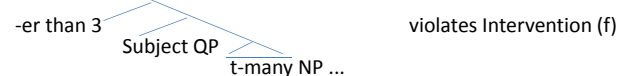
h. Scope commutativity facts of comparative quantifiers.

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Subject QP and splitting counter
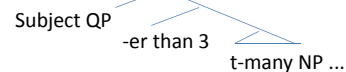
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Further properties of counters

Counters host adnominal *each*.
  ✓ *The girls read more than ten books each.*
  compare #*The girls read most of the books each.*
      #*The girls read some books each.*
      # *The girls read books each.*

Their internal composition matters for acceptability, interpretation, and processing:

more than 50% of the NP vs. *most of the NP*,
more than six books vs. *at least seven books*,
fewer than seven books vs. *at most six books*

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Interface Transparency

"Extending other work, our conclusion is that competent speakers associate sentences with canonical specifications of truth conditions, and that these specifications provide default verification procedures. From this perspective, examining how a sentence constrains its verification can provide clues about how speakers specify the truth condition in question. More generally, our data support an Interface Transparency Thesis (ITT), according to which speakers exhibit a bias towards the verification procedures provided by canonical specifications of truth conditions. In conjunction with specific hypotheses about canonical specifications, the ITT leads to substantive predictions, because given available information, the canonical procedure may have to rely on (noisy) input representations that lead to less accuracy in judgment, compared with an alternative strategy that is cognitively available to speakers."
(Lidz et al. 2011)

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Dissecting Quantifiers
Lecture 3
Towards compositionality
in quantifier words

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- **Compositionality**
  The meaning of a complex expression is a function of the meanings of its parts and how they are put together.

- **What are the "parts"?**
  This question can be asked in many ways: Surface constituents? LF constituents? Only audible parts? Also phonetically empty ones? What about type shifters? Etc.

- **Our question**
  Are **phonological words** necessarily parts, even minimal (primitive) parts**,** that a compositional grammar should take into account? If not, what parts are to be recognized?

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Lessons from Distributed Morphology and some versions of Minimalist Syntax

Distributed Morphology
   (Halle & Marantz 1994; Embick 2010; and others)

Hierarchical syntactic structure all the way down to roots; Late Insertion of vocabulary items.

The architecture is compatible with various different theories of locality and linearization.

The typological differences between polysynthetic and isolating languages do not require the postulation of radically different mechanisms in UG.

The phonological word has no special status in semantic interpretation.

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The phonological word has no special status in semantic interpretation
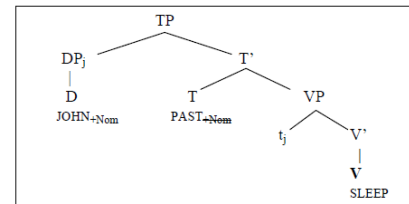
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Lessons from Distributed Morphology and some versions of Minimalist Syntax

Some versions of Minimalist syntax
   (Julien 2002; Kayne 2005a,b, 2010; Koopman 2005; Koopman & Szabolcsi 2000; Sigurðsson 2004; Starke 2009; many others)

Each syntactic head carries one and only one feature. Then, phonological words correspond to potentially large chunks of syntactic structure.

Especially when remnant movement is allowed, many words will not even correspond to complex heads assembled by head movement in syntax, because at least some of the building blocks are phrases.
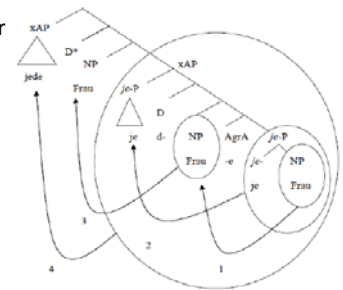
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Many words will not even correspond to complex heads assembled by head movement in syntax

Example: *jede Frau* `every woman' (Leu 2009)
jeder   *je* `distributive particle'
            d `relative complementizer
            adjectival agreement

gut-**er** Mann   je–d–**er** Mann
gut-**e** Frau   je–d–**e** Frau
gut-**es** Kind   je–d–**es** Kind
d-**er** Mann
d-**ie** Frau
d-**as** Kind

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Moral

- Words are not distinguished building blocks in syntax or morphology.
- Then, we do not expect words to be distinguished building blocks for compositional semantics.

- Specifically, "words" are not compositional primitives. Complex meanings cannot be simply written into the lexical entries, without asking how the parts of the word contribute to them. Parts of a "word" may also reach out to interact with, or operate on, the rest of the sentence.

Today's topic

In many languages, the same particles build quantifier words and serve as connectives, additive and scalar particles, question markers, existential verbs, etc.

Are these particles "the same" across the varied environments? If so, what is their stable meaning?

Or, are they lexicalized with various distinct meanings that bear a family resemblance?

Here are some first steps and preliminary results.

A sampler from Hungarian

ki who	*ki* is an "indeterminate pronoun"	
vala-*ki* someone	*X vagy Y* X or Y	*vagy* hat approx. 6
vala (volt) [there] was	*vagy*-on (van) [there] is	*vaj*-j-on puzzling particle
mind-en-*ki* everyone	*mind X, mind* Y both X and Y	Ti *mind* VP. you all VP
se-n-*ki* no one …	*se X, se Y* neither X nor Y	

Japanese KA
somewhat similar to *vala/vagy*

dare-**ka**	`someone'
gakusei-no dare-**ka**	`some student' (=one of the …)
jyuu-nin-to-**ka**-no gakusei	`some ten students' (=approximately)
Tetsuya-**ka** Akira(-**ka**)	`Tetsuya or Akira'
Dare-ga odorimasu **ka**	`Who dances?'
Akira-ga odorimasu **ka**	`Does Akira dance?'

Japanese MO
somewhat similar to *mind*

dare-**mo**	`everyone/anyone' (depending on stress)
jyuu-nin-**mo**-no gakusei	`as many as ten students'
Tetsuya-**mo** Akira-**mo**	`both Tetsuya and Akira'
Tetsuya-**mo**	`also/even Tetsuya' (depending on stress)

Chinese DOU
somewhat similar to *mind* and *mo*

tā nǎ-gè xuéshēng **dōu** xǐhuān	`every student'
tāmen **dōu** mǎi-le yì-bù chēzi	`they all VP'
yí-gè-rén **dōu** méi xiào	`not a single person'
tā shíwǔ-gè píngguǒ **dōu** chī-le	`as many as ten'
wǒ [xuěgāo]$_F$ **dōu** xiǎng chī	`even ice-cream'
ngo^5 [syut^3 gou^1]$_F$ **dou**^{1} soeng^2 sik^6	`ice-cr. too'

Questions

Do the roles of each particle form a natural class?
If yes, what is the **unifying syntax/semantics**?

Is the particle aided by additional, overt or covert, elements in fulfilling its varied roles? If yes, what are those elements?

What do we learn from the cross-linguistic similarities and differences in the distribution and interpretation of these particles?
E.g. ka ≠ vala/vagy, mo ≠ mind ≠ dou, …

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Unifying option 1: Boolean semantics

Everyone dances, $\forall$x[dance(x)]   iff
Kate dances, **and** Mary dances, **and** Joe dances,
dance(k) $\wedge$ dance(m) $\wedge$ dance(j)

Someone dances, $\exists$x[dance(x)]   iff
Kate dances, **or** Mary dances, **or** Joe dances,
dance(k) $\vee$ dance(m) $\vee$ dance(j)

Universal quantification and conjunction are special cases of the Boolean **intersection (lattice-theoretic meet)** operation, and existential quantification and disjunction are special cases of the Boolean **union (lattice-theoretic join)** operation.

14

Meet and join

[A, $\geq$] is a partially ordered set iff $\geq$ is a reflexive, transitive, anti-symmetrical relation on the set A.

- For any subset X of A, b$\in$A is a lower bound for X iff for every x$\in$X, x$\geq$b.
  The greatest of these, if there is one, is the **glb** (infimum) of X.
- For any subset X of A, c$\in$A is an upper bound for X iff for every x$\in$X, c$\geq$x.
  The least of these, if there is one, is the **lub** (supremum) of X.

Let a two-element subset of A be {d,e}.
The glb (infimum) of {d,e} is the meet of d and e, written as d$\wedge$e.
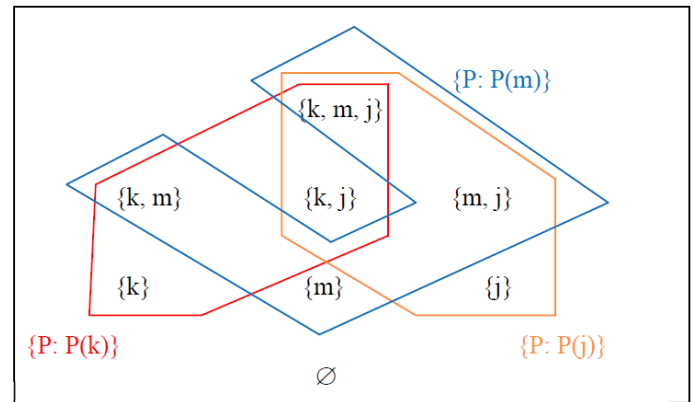The lub (supremum) of {d,e} is the join of d and e, written as d$\vee$e.

Conjunction of propositions (p$\wedge$q) and intersection of sets (P$\cap$Q) are special cases of meet.
Disjunction (p$\vee$q) and union (P$\cup$Q) are special cases of join.

15

[[Kate]] = {P: P(k)}, etc.

Universals and existentials

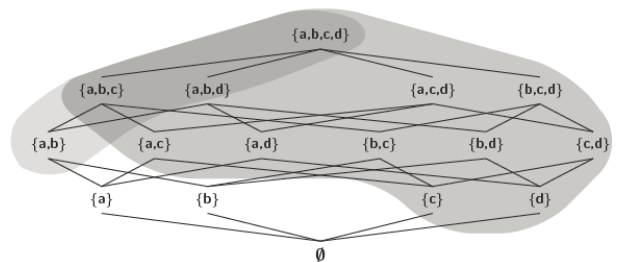[[every**one**]]   is the intersection of the sets of properties of the individuals in the universe
{P: P(k)} $\cap$ {P: P(m)} $\cap$ {P: P(j)}   or, equivalently
{ P: P(k) $\wedge$ P(m) $\wedge$ P(j) }

[[some**one**]]   is the union of the sets of properties of the individuals in the universe
{P: P(k)} $\cup$ {P: P(m)} $\cup$ {P: P(j)}   or, equivalently
{ P: P(k) $\vee$ P(m) $\vee$ P(j) }

17

{P: every dragon(P) $\wedge$ at least one serpent(P)}

Fig. 4.1 The intersection of two generalized quantifiers
every dragon′ = {{a, b}, {a, b, c}, {a, b, d}, {a, b, c, d}}
at least one serpent′ = {{c}, {d}, {a, c}, {a, d}, {b, c}, {b, d}, {c, d}, {a, b, c}, {a, b, d}, {a, c, d}, {b, c, d}, {a, b, c, d}}
every dragon and at least one serpent′ = {{a, b, c}, {a, b, d}, {a, b, c, d}}

18

Supplements to the Boolean option

How does KA as a question-marker fit in?
Questions denote the sets of their possible answers.
Notation: $^\wedge$dance(k) = λw[dance(w)(k)] = {w: dance(w)(k)} =
= the proposition that Kate dances

Does Kate dance? à la Hamblin/Karttunen
{ p: p = $^\wedge$dance(kate) $\vee$ p =$^\wedge$not-dance(kate) }
`the set of propositions that are identical to "Kate dances" or to "Kate doesn't dance"'

Who dances? à la Hamblin/Karttunen
{ p: p=$^\wedge$dance(k) $\vee$ p=$^\wedge$dance(m) $\vee$ p=$^\wedge$dance(j) }
`the set of propositions that are identical to "Kate dances," or to "Mary dances," or to "Joe dances"'

Supplements to the Boolean option

How does MO as *also/even* fit in?
> *Kate also dances*
> *Even Kate dances*

both entail "someone other than Kate dances,
and Kate dances"

But "someone other than Kate dances" is thought to be a presupposition, so MO is not, or not just, intersection.
Also: Neither MO, nor the Hungarian/Chinese counterparts express plain `and'.

Unifying option 2:
KA signals multiple alternatives

Who dances? à la Hamblin/Karttunen:
{p: p=$^\wedge$dance(k) $\vee$ p=$^\wedge$dance(m) $\vee$ p=$^\wedge$dance(j)}
same as {$^\wedge$dance(k), $^\wedge$dance(m), $^\wedge$dance(j)}

Kate dances, or Mary dances, or Joe dances,
re-interpreted à la Alonso-Ovalle:
{$^\wedge$dance(k), $^\wedge$dance(m), $^\wedge$dance(j)}

Someone dances re-interpreted à la AnderBois:
{$^\wedge$dance(k), $^\wedge$dance(m), $^\wedge$dance(j)}

Hamblin-style alternative semantics, 1
(Kratzer & Shimoyama 2002, Rooth 1992)

Indeterminate pronouns contribute multiple alternatives that project up (here, from *dare* to *dare nemutta*). Otherwise singleton sets of alternatives.

[[**dare**]]w,g = { x: human(x)(w) }
[[**nemutta**]]w,g = { λx λ w'. slept(x)(w') }
[[**dare nemutta**]]w,g = { p: $\exists$x [human(x)(w) &
$\quad$ p = λw'. slept(x)(w')] }
[[**Akira nemutta**]]w,g = {p: p = λw'. slept(akira)(w')}

Hamblin-style alternative semantics, 2

Propositional operators apply to A = {p : ... p=... }:

[$\exists$](A) = {the p that is true in all worlds in which
$\quad$ some p in A is true}
[$\forall$](A) = {the p that is true in all worlds in which
$\quad$ every p in A is true}
[Neg] (A) = {the p that is true in all worlds in which
$\quad$ no p in A is true}
[Q](A) = A, i.e. Question retains the set of p's in A

Focus à la Rooth: *[KATE]$_F$ dances*
$\quad$ ordinary meaning: $^\wedge$dance(k)
$\quad$ focus alternatives: {$^\wedge$dance(k), $^\wedge$dance(m), $^\wedge$dance(j)}

Multiple alternatives are only used as a stage in the computation (except for questions).

Inquisitive semantics
Ciardelli-Groenendijk-Roelofsen 2012

- All (declarative/interrogative) sentences denote issues = sets of classical propositional alternatives.
- Interrogatives, disjunctions, and sentences with indefinites denote sets of multiple alternatives, whereas plain *Kate dances* denotes a singleton set of alternatives.
- Linguistically similar to alternative semantics, but multiple alternatives are not (necessarily) eliminated via quantifiers.
- We can now say:
  All KA-sentences raise multiple-alternative issues.

The algebraic-Inquisitive perspective subsumes the Boolean one as a special case
(Roelofsen 2012)

Heyting algebra: distributed lattice with top and bottom. Has meet and join, but "relative pseudo-complement" instead of complement. Doesn't have double-negation elimination.

But if the pseudo-complement is a complement, the Heyting algebra is also a Boolean algebra.

Def.: *a's pseudo-complement relative to b is $a{\rightarrow}b$*: $(a{\rightarrow}b)\wedge a \leq b$, and moreover $a{\rightarrow}b$ is the greatest such in that if $c\wedge a \leq b$ then $c \leq a{\rightarrow}b$.

E.g., [{0, ½, 1}, $\geq$] is a Heyting algebra, but not a Boolean algebra.

More on Inquisitive Semantics

Main interest: sentences that leave alternatives open (are inquisitive), rather than use up alternatives by quantifying over them. Disjunctions, questions, sentences with indefinites denote live issues (sets of multiple alternatives), unlike conjunctions, negations, universal claims, etc.

[Figures from S. AnderBois 2013, Yucatec Maya…, *NALS*]
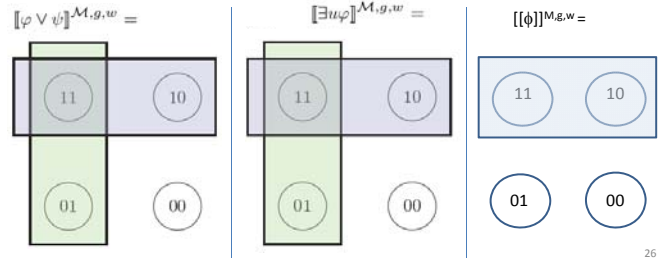
Non-inquisitive closure (!): $[\![!\varphi]\!] := [\![\neg\neg\varphi]\!] = \{\bigcup[\![\varphi]\!]\}$
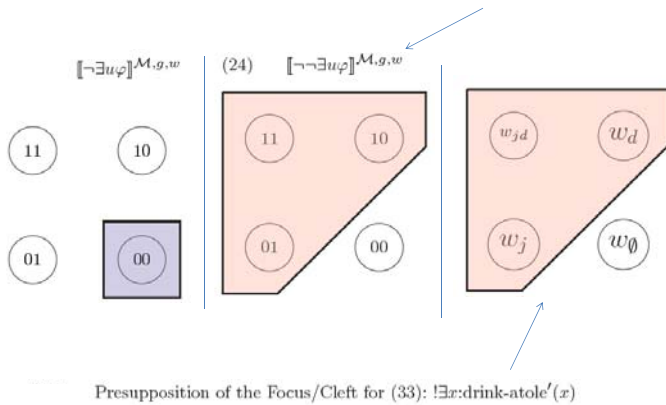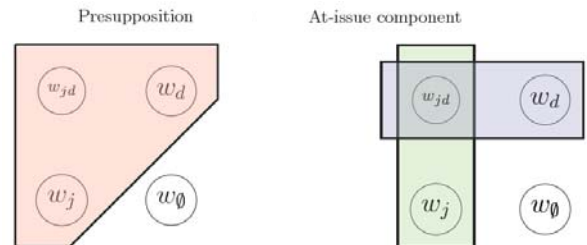

Presupposition of the Focus/Cleft for (33): $!\exists x{:}\text{drink-atole}'(x)$

Sentences with disjunctions / indeterminate pronouns,
<u>used as</u> questions when $\exists$ presupposition of focus eliminates the informative content, and whole universe is covered with alternatives

---

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Dissecting Quantifiers
Lectures 4 and 5
What do quantifier particles do?

Anna Szabolcsi,
New York University
SCILLS 2013
http://scills.btk.ppke.hu/

1

First approximation

Notation: Capitalized KA and MO are generic cross-linguistic representatives of the two classes of particles (not specifically Japanese ones).

KA is a disjunction (join) operator of some sort.
MO is a conjunction (meet) operator of some sort.

Jayaseelan has proposed this, but he didn't address a Big Problem.

2

The Big Problem

- Sinhala (KA = hari / də)
  John-KA Mary-KA ran. `John or Mary ran'
  John-KA Mary-KA ran? `Did John run, or did Mary?
- Japanese (MO = mo), Russian (MO = i), Hungarian (MO = mind / is)
  John-MO Mary-MO ran `Both John and Mary ran'
- Russian (KA = li), Hungarian (KA = -e)
  ... John ran-KA
  ... John ran or not   `whether John run'
  ... John ran-KA or not

3

Too many actors for one role

If KA = $\vee$ and MO = $\wedge$, then they shouldn't occur more than once in constructions that mean a$\vee$b and a$\wedge$b.

But we want to preserve the observation that KA and MO occur precisely in constructions that mean a$\vee$b and a$\wedge$b!

4

Options

1st Option   KA and MO are meaningful, but their purpose in the compositional process is not directly related to $\vee$ and $\wedge$.

2nd Option   KA and MO are meaningless syntactic elements that point to (possibly silent) meaningful $\vee$ and $\wedge$ operators. Compare +/- interpretable features.

3rd Option   KA and MO are meaningful elements that point to joins and meets in a semantic way. Compare presuppositions.
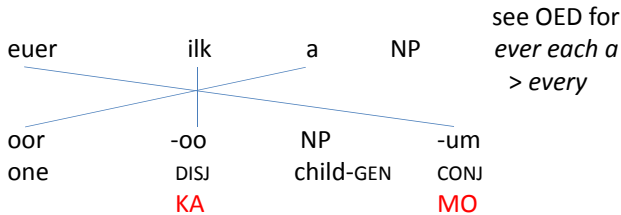
5

- KA and MO are meaningful, but their purpose in the compositional process is not directly related to $\vee$ and $\wedge$. KA=choice function variable; Hagstrom 1998, Yatushiro 2002, 2009, Cable 2010 , Slade 2011.
- KA and MO are meaningless syntactic elements that point to (possibly silent) meaningful $\vee$ and $\wedge$ operators. Compare +/- interpretable features. Not yet proposed, but in the spirit of Carlson 1983, 2000; Ladusaw 1992; etc.
- KA and MO are meaningful elements that point to joins and meets in a semantic way. Compare presuppositions; Szabolcsi 2013.
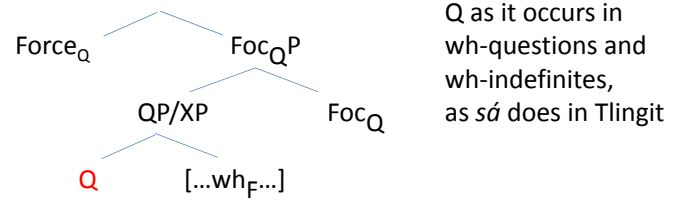
6

Previous analyses of KA (and MO)

Jayaseelan (..., 2011: 281)

"In a distributive universal quantifier like *oor-oo kuTTi-(y)um* ['every child']... The *-oo* forms the cells of the partition, and *-um* collects the disjuncts together and gives us a universal quantifier. What we get as a result is a partition of the class of 'child', such that each cell of the partition has just one member."

				see OED for
euer	ilk	a	NP	*ever each a*
				> every

oor	-oo	NP	-um
one	DISJ	child-GEN	CONJ
	KA		MO

7

Cable 2010: wh ≠ **Q** ≠ Force

Q as it occurs in wh-questions and wh-indefinites, as *sá* does in Tlingit

```
      Force_Q         Foc_Q P
                   QP/XP       Foc_Q
                 Q      [...wh_F...]
```

What we used to call wh-movement is QP (or Q) mvmnt.
Q is a choice function variable.
QP (or Q) moves to $Foc_Q P$ to be near $Force_Q$.
$Force_Q$ Agrees with Q, ∃-closes Q and forms set of props.

$Force_{Q,i} = \lambda p\,.\,\exists f\,.\,p=[[YP]]^{g(i/f)}$ (single-wh question)

8

Q = KA?

Cable proposes that the theory of Q-particles only needs to cover wh-indefinites and wh-questions, marked by *sá* in Tlingit. Japanese *ka* represents massive homonymy.

Slade 2011 shows that the homonymy thesis is diachronically and cross-linguistically implausible (see table, next slide) and accounts for spell-out distinctions using, mainly, syntactic features.

Slade modifies some aspects of Cable's semantics (role of focus, etc.), and extends the choice-functional analysis to all roles of KA.

9

Slade 2011

	Mod. Sinh	Old Mal	Mod Mal	Tlin	Jap
y/n-ques.	də	-oo	-oo	gé	ka, no, kai, kadooka
wh-ques.	də	-oo	—	sá	ka, no, ndai
wh-indef.	də (aff.), hari (aff.), vat(neg.)	-oo	-oo	sá	ka
decl. disj.	hari (aff.), vat (neg.)	-oo	-oo	khach'u	ka
interr. disj.	də	-oo	-oo	gé... gwáa	[ka]

Distribution of Q-particles in Sinhala, Malayalam, Tlingit, and Japanese

10

Cross-linguistic distribution, syntactic feature account (Slade 2011)

ModColl Sinhala   Tlingit   Japanese

CATEGORY	FEATURE(S)
C-INT	uQ[ ], iInt[+]
wh-pronoun	
də	iQ[+]
hari	
J	

CATEGORY	FEATURE(S)
C-INT	uQ[ ], iInt[+]
wh-pronoun	
sá	iQ[+]
gé	iQ[+], uJunc[ ], uInt[ ]
khach'u	uJunc[ ], iInt[-]
J	iJunc[+], uInt[ ]

CATEGORY	FEATURE(S)
C-INT	uQ[ ], uInt[+]
wh-pronoun	iWh[+]
ka	iQ[+]
no	iQ[+], uInt[ ]
ndai	iQ[+], uInt[ ], uWh[ ]
kai/kadooka	iQ[+], uInt[ ], uJunc[ ]
J	iJunc[+]

E.g. uQ[] C-INT needs iQ[+] *da/sa/ka*.
The latter help, but don't need, C-INT.

11

Slade 2011

Q as it occurs in yes/no questions, wh-questions, wh-indefinites, declarative disjunctions, alternative qu's.

Wh-words (indeterminate pronouns) and disjunctions (headed by den Dikken's 2006 Junction) have sets of alternatives as their ordinary semantic values.

Q-particle is present when alternatives are introduced. Q "domesticates" alternatives.

Q-particle is a choice function. Applies to Hamblinian alternative sets and delivers Montagovian types.

$[[C\text{-}INT_i\ XP]]g = \lambda p[\ \exists f_{CH}.\ p=[[XP']]^{g(f/i)}\ ]$

[[-e]] (focus suffix on V)   adds ∃ presupposition

12

Recap: Choice functions cf

A choice function cf looks at every set and chooses an element of that set. **dog(cf(dog)) always true**

$cf\_1(dog)$= Fido $cf\_2(dog)$=Spot   ...
$cf\_1(cat)$=Max $cf\_2(cat)$=Tiger   ...
$cf\_1(city)$=Paris $cf\_2(city)$=LA   ...
$cf\_1(two\text{-}dogs)$= $cf\_2(two\text{-}dogs)$=
    {Fido, Spot}   {King, Spot}   ...
...   .

also with sets whose elements are not individuals:
two-dogs' =   { {Fido, Spot}, [King, Spot], {Spike,King},
              {Fido,King}, {Fido,Spike}, {Spike,Spot} }

13

Why are Q-particles present in all these constructions, cross-linguistically?

- Choice functions have been used

... to account for the island-free scope of indefinites (but those cfs always reside inside the island; neither move, nor are attached to the island), or

... to be skolemized and thus encode how indefinites are dependent on particular quantifiers (is it perhaps useful for pair-list readings, not discussed in this literature?).

But, choice-functional analyses are by-and-by abandoned.

- Do alternatives really have to be "domesticated"?

Quantifiers could operate directly on sets of alternatives, cf. generalized quantifier theory: Q(restriction)(scope).

The main idea of Inquisitive Semantics is that multiple alternatives are viable and important.

14

2nd option (cf. slide 5)

KA and MO are meaningless syntactic elements that point to (possibly silent) meaningful $\vee$ and $\wedge$ operators. Compare +/- interpretable features.

Not yet proposed, but in the spirit of Carlson 1983, 2000 for all functional categories; Ladusaw 1992 for negative concord; etc.

Could work. But I'm going to argue that the semantic route is also viable and interesting.

15

3rd Option
to be reviewed in what follows

KA and MO are meaningful elements that point to joins and meets in a semantic way.

Proposed in Szabolcsi 2013. Main focus is on KA, but MO plays a vital supporting role at various points.

Recall the Big Problem:

multiple occurrences of KA and MO in $a\vee b$, $a\wedge b$.

16

Inspiration: Kobuchi-Philip 2009 on *mo*

(gakusei-ga) John-**mo** hashitta   additive
`(Among the students,) John also ran'   presupposition

(gakusei-ga) [John-to Mary]-**mo** hashitta   additive
`(Among the students,) John and Mary also ran'   presupposition

(gakusei-ga) John-**mo** Mary-**mo** hashitta   reciprocally
`(Among the students,) both John and Mary ran'   satisfy prspp

(gakusei-ga) dono-hito-**mo** hashitta   reciprocally
`(Among the students,) every person ran'   satisfy prspp

Lesson I draw:
- KA and MO carry semantic requirements -- presuppositions.
- The hosts of multiple occurrences mutually satisfy the presuppositions of each other's particles.

17

Hungarian *Mind* -- *Is* -- *És*
Observations re: Japanese carry over.
Szabolcsi, Whang, & Zu 2013

mind Kati, **mind** Mari   `Kati-**mo** Mari-**mo** (both)'
mind-en-ki   `dono-hito-**mo** (every)'
A fiúk **mind** VP.   ca. `the boys **dou** VP (all)'

Kati **is**   `Kati-**mo** (also/even)'
[Kati **és** Mari] **is**   `[Kati-**to** Mari]-**mo** (also/even)'
Kati **is** (**és**) Mari **is**   `Kati-**mo** Mari-**mo** (both)'

[Kati **és** Mari]   `Kati-**to** Mari'

18

Proposal: KA wants to be in a "possibility-increasing" environment.

- Let XP and YP denote (be interpreted as) the issues [[XP]] and [[YP]]. KA attaches to XP, and YP is the next issue-denoter above.

- We say that KA is in a **possibility-increasing environment** if all the possibilities in [[XP]] are preserved in [[YP]], and [[YP]] contains other possibilities as well:
[[XP]]⊂[[YP]]

YP
… XP-KA
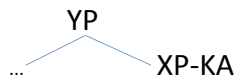
Inquisitive semantic toolkit

- All sentences are interpreted as **issues**: sets of possibilities. A **possibility** is a set of worlds.
- A **maximal possibility** corresponds to a classical proposition that plays the role of a linguistic **alternative**.
- Inquisitive and non-inquisitive issues are of the same logical type. They differ in that **inquisitive issues** are **non-singleton** sets of maximal possibilities (alternatives), whereas **non-inquisitive** ones are **singleto**n sets of maximal possibilities (alternatives).

More precisely, an **issue** is non-empty, **downward closed** set of sets of worlds that jointly cover what we may call the world-universe of discourse.
Downward closure: If t∈I and t'⊆t, then t'∈I.

An issue with three max. possibilities
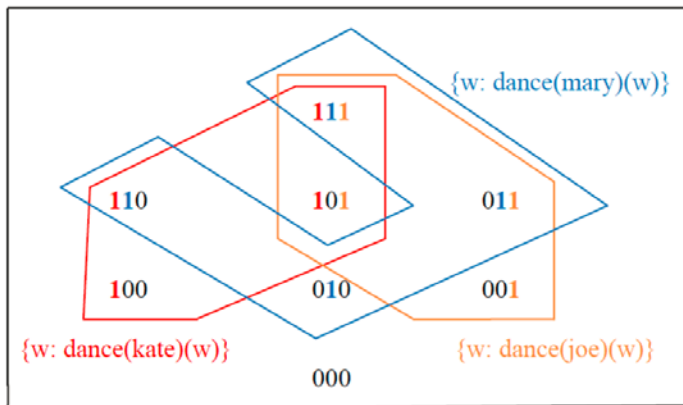
- In the diagram, every world is represented with three digits that specify the truth values of three atomic sentences, the only sentences that we care about.
- For example, "100" stands for "Kate dances, Mary does not, Joe does not," and the red box encloses the set of all those worlds in which <u>Kate dances</u> is true.
- Each of the boxed areas constitutes a max. possibility (alternative), and the three max. possibilities (alternatives) together constitute the issue: we are uncertain as to which area the actual world lies in.
- Compare the isomorphic diagram with GQs:
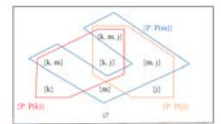
✓XP-KA, if YP is a disjunction: [[XP]]⊂[[YP]]

[[Joe dances]] = { POW{w: dance(w)(joe)} }
    = { POW{001, 011, 101, 111} } =
    = {{001}, {011}, {101}, {111},
       …, {001, 011, 101, 111}}
[[Joe dances or Kate dances]] =
    = { POW{w: dance(w)(joe)},
         POW{w: dance(w)(kate)} }

Notation: POW `powerset (=the set of all subsets) minus ∅' . Needed b/c of downward closure.

#XP-KA, if YP is a conjunction: [[XP]]⊄[[YP]]

[[Joe dances]] = { POW{w: dance(w)(joe)} }
    = { POW{001, 011, 101, 111} }
    = {{001}, {011}, {101}, {111},
       …, {001, 011, 101, 111}}
[[Joe dances and Kate dances]] =
= { POW{w: dance(w)(joe) & dance(w)(kate)} }
= { POW{w: dance(w)(joe) ∩ POW{w: dance(w)(kate)} }
= { POW{101, 111} }

E.g. {001} ∈ [[J dances]] but ∉ [[J dances & K dances]]

All the well-known environments of KA are possibility-increasing

- Disjunctions
- Wh-questions
- Yes/no questions
- Sentences with indefinites (that do not fall within the scope of negation or other externally static operators)

Szabolcsi 2013 adds

- Approximate number constructions
- Questions with "puzzle particles,"
    H. *vajon*, R. *oare*, G. *ob*, etc.

25

J(unction), silent MEET and silent JOIN

On my proposal, all the semantic action of joining and meeting issues has to be performed by actors other than KA or MO. Who are they?

Winter 1995, 1998
A <u>and</u> B = A•B = ⟨A, B⟩ = mere pair-former.
Pairs grow pointwise (like Hamblinian alternatives).
At some point silent ∩ applies, creating the illusion that <u>and</u> scopes there.
<u>And</u> can also be silent (asyndetic conjunction). <u>Or</u> is cross-linguistically almost never silent (no asyndetic disjunction).
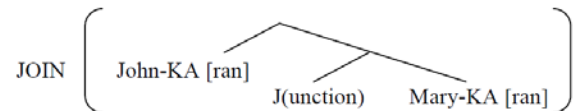
26

Proposal

- Identify <u>and</u> / its silent counterpart, interpreted as Winter's •, as den Dikken's 2006 J(unction) head.
- Replace Winter's plain Boolean MEET ∩ with Dekker's 2012 order-sensitive ∩. Dekker's MEET interprets the 2nd disjunct strictly in the context of the 1st (cf. anaphora).
- Introduce also silent JOIN, ∪.
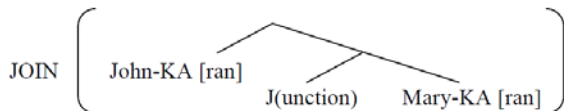
27

John-KA (ran) • Mary-KA (ran)
= ⟨{POW{w: ran(w)(john)}}, {POW{w: ran(w)(mary)}}⟩

JOIN (⟨{POW{w: ran(w)(john)}}, {POW{w: ran(w)(mary)}}⟩)
= {POW{w: ran(w)(john)}, POW{w: ran(w)(mary)}}

But wait. Null join must not come for free. Winter taught us that cross-linguistically, disjunctions do not go unmarked.

28

Overt KA is needed only in disjunctions. It bleeds the default null operator, MEET.

KA requires the presence of increasing possibilities that may arise in indefinites, questions, and disjunctions.

Of these, bare wh-words can function as question words or indefinites (Haida 2007), and main clause yes/no questions are often only marked by intonation.

Wer mag WAS?	Wer MAG was?
who likes what	who likes what
`Who likes what?'	`Who likes something?'

The overt marking of disjunctions is needed due to the existence of null MEET, the default. The presence of KA, with its [[XP]]⊂[[YP]] requirement, forces the pair to be fed to JOIN and thus pre-empts MEET.

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Support from complex connectives
(with my reinterpretations)

- Arsenijević 2011

S-C *ili* = *i* + *li*   *i* `and=J' + *-li* `KA'

- Mitrović 2012, 2013

arma(que) J$_\varnothing$ virum-que   `arms and a man'
arms(MO)   •   man-MO

                                                    `having mercy and
miserando at-que eligendo   choosing him'
CP1-MO$_\varnothing$ J-MO   CP2

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KA in Hungarian

vala-ki	'someone'
vala-mi diák	'some student (= identity is unknown or irrelevant)'
vala-mi tíz diák	'some 10 students (=approx. 10)'
Kati **vagy** Mari	'Kate or Mary'
vagy Kati **vagy** Mari	'either Kate or Mary, not both'
vagy tíz diák	'some 10 students (=approx./at least)'
vagy-, **val**-	allomorphs of 'be' (existential, locative, predicative copula)
vajon	'puzzlement' (optional question modifier)

Plus an item that is etymologically unrelated:

-e	`yes/no particle, attaches to the finite V or, in ellipsis, to focus'

KA in polar questions

- Recap: Hamblin/Karttunen interpret <u>Does John walk?</u> as {{w: walk(w)(j), {w: ¬walk(w)(j)}}, and InqS's *?* operator abbreviates $\varphi \vee \neg\varphi$ as $?\varphi$.

- Are R. -li and H. -e "or not"? At first glance, it seems so.

Ja ne   znaju, prishel li Ivan domoj.   ... megjött-e?
I not know came   LI Ivan home
`I don't know whether Ivan came home'

Ja ne   znaju, prishel Ivan ili ne prishel. ... megjött vagy nem?
I not know came   Ivan or not came
`I don't know whether Ivan came or didn't come'

But -*li* and -*e* don't only alternate with OR NOT. They also co-occur with it.

Ja ne   znaju, prishel li Ivan ili net.
I not know came   LI Ivan or not
`I don't know whether Ivan came or not'

Nem tudom, hogy megjött-e János vagy nem.

Proposal:
Li and -*e* carry the same possibility-increasingness requirement as other members of the KA family.
Not-p is easily accommodated: it is the only possible mutually exclusive alternative.

Questions raise mutually exclusive alternatives

- In wh-questions, (one of) the question-words is focused. Focus-sensitive EI-OP (Szabolcsi, Haida, Horvath) ensures exhaustivity, hence the mutual exclusivity of alternatives.

- In alternative questions, all of the alternatives are individually focused. Again, EI-OPs ensure exhaustivity, hence the mutual exclusivity of alternatives.

- Yes/no (polar) questions do not require focus, b/c the two alternatives are mutually exclusive anyway.

Conclusion

```
        YP
      /    \
...  /      \  XP-KA
```

- KA requires [[XP]]⊂[[YP]] (possibility-increasingness). This holds of all members of the KA-family. KA does not perform JOIN. KA does the same thing in both disjuncts.

- Overt KA is only necessary in disjunctions, where it bleeds the default, silent order-sensitive MEET in OP(⟨[[XP1]], [[XP2]]⟩), where OP=MEET or JOIN.

- KA is not necessary in its other roles. Cross-linguistically, absence/null versions are attested.

This discussion focused on conjunctions, disjunctions and polar questions.

Make the formalization precise for universals, indefinites, and wh-questions, along the lines of Kobuchi-Philip 2009, Bumford 2013.

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