DECOMPOSING DISJUNCTION

THE MORPHOSEMANTIC MAKEUP OF XOR

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INTRODUCTION

WHAT THIS TALK IS ABOUT, IN A NUTSHELL

- This talk is about a seemingly **illogical** fact of language that has gone unnoticed:

$\boxed{\text{or+and}}$ John $\boxed{\text{or+and}}$ Mary = $\boxed{\text{either}}$ John $\boxed{\text{or}}$ Mary

- Two logically opposite particles build a complex particle that expresses strong disjunction (XOR).
- A sketch of these particles ...

INTRODUCTION

SUPERPARTICLES: TWO LOGICAL ATOMS

SUPERPARTICLES: TWO LOGICAL CLASSES IN JAPANESE

The μ-series (*mo*)

The κ-series (*ka*)

SUPERPARTICLES: TWO LOGICAL CLASSES IN JAPANESE

The μ-series (*mo*)

a. Bill **mo** Mary **mo**
B μ M μ
'(**both**) Bill **and** Mary.'

The κ-series (*ka*)

a. Bill **ka** Mary **ka**
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SUPERPARTICLES: TWO LOGICAL CLASSES IN JAPANESE

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b. Mary **mo**
M μ
'**also** Mary'

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a. Bill **ka** Mary **ka**
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b. wakaru **ka**
understand κ
'Do you understand**?**'

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a. Bill **mo** Mary **mo**
B μ M μ
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b. Mary **mo**
M μ
'**also** Mary'

c. dare **mo**
who μ
'**every-/any-**one'

The κ-series (*ka*)

a. Bill **ka** Mary **ka**
B κ M κ
'(**either**) Bill **or** Mary.'

b. wakaru **ka**
understand κ
'Do you understand**?**'

c. dare **ka**
who κ
'**some**one'

MORPHOLOGICAL COMPLEXITY & LOGICAL SIMPLICITY

- There seems to exists a **disharmonic mapping** between the **morphologically complex particle clusters** and the **logically/semantically simple meanings** they contribute.

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The Morphosemantic Principle

"Compositional analysis cannot stop at word-level." (Szabolcsi, 2010, 189, ex. 1)

INTRODUCTION

DISJUNCTIONS, IMPLICATURES, ALTERNATIVES

AMBIGUOUS 'OR' IN ENGLISH

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  a. Either it carries an IGNORANCE implicature,
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b. (1) $\rightsquigarrow [j \vee b] \wedge \neg[j \wedge b]$
"**Mary saw John or Bill, but not both**."

FORMALISING ALTERNATIVES & THEIR PRUNING

$j \vee b$

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$j \vee b$ ⟵ assertion

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FORMALISING ALTERNATIVES & THEIR PRUNING

$j \vee b$ $\longleftarrow$ assertion

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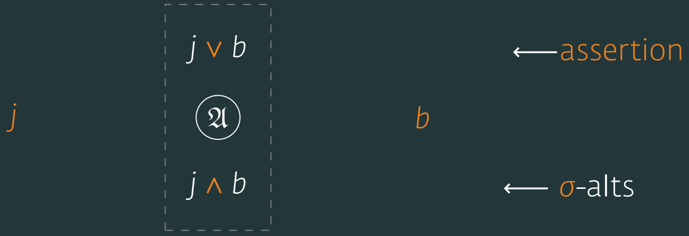
FORMALISING ALTERNATIVES & THEIR PRUNING



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FORMALISING ALTERNATIVES & THEIR PRUNING

$j \vee b$ ⟵ assertion

j $\quad \textcircled{\mathfrak{A}} \quad$ b ⟵ δ-alts

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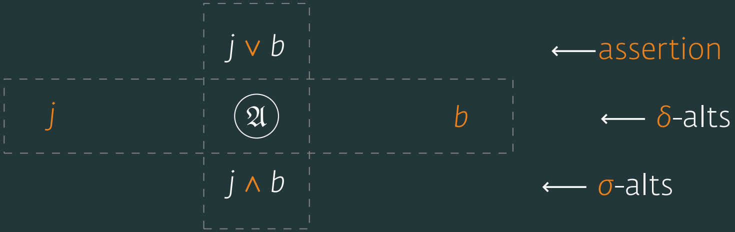

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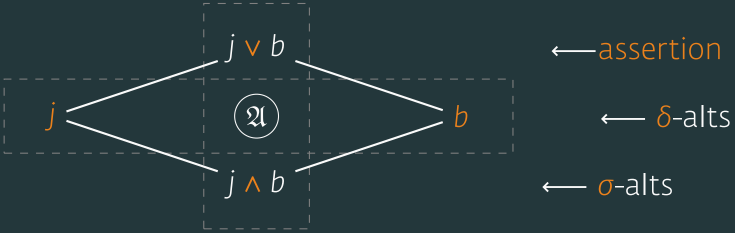

∴ There two kinds of alternatives: **subdomain** (δ) and **scalar** (σ) ones.

- The choice between which ones are relevant is made in syntax using a covert exhaustification operator akin to a silent '**only**' – $\mathfrak{X}$.

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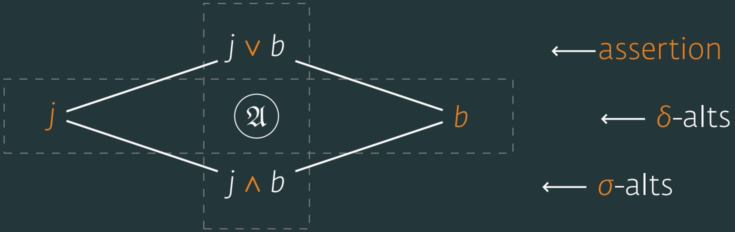

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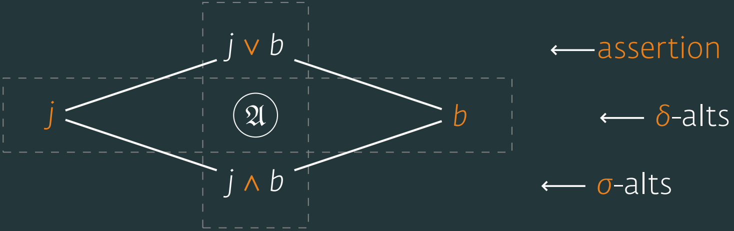

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THE SILENT EXHAUSTIFIER

- The operator $\mathfrak{X}$ is a silent variant of the adverb '**only**'.
- What does it mean?

(2) $$\mathfrak{X}(p) = p \wedge \forall q \in \mathfrak{A}(p)\Big[[p \nvdash q] \rightarrow \neg q\Big]$$

- This LF is read as: **the assertion, p, is true and any non-entailed alternative to the assertion, q an alternative, is false.**

THE SILENT EXHAUSTIFIER: A SKETCH OF APPLICATION

- Consider the enriched F-associated meanings:

(3) Mary saw John.

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- Consider the enriched F-associated meanings:

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b. Mary saw JOHN. . . . . δ-ALTS TRIGGERED!

- We take (3b) to be rather analogous to (3a):

(4) $\Big[\, \mathfrak{X}_{[\mathfrak{A}:\delta]}\, [\text{ Mary saw JOHN}_{\delta}\ ]\Big]$

- Exhaustification need not result in intonational marking. (SKETCH)
- Some words have constantly active alternatives (inversely, Focus may activate otherwise passive alternatives).
- This activity is syntactically visible by a presence of (one of the) $[\sigma, \delta]$ features.
- A class of these constantly-$\mathfrak{A}$-active words includes **indefinites**, **disjunctions**, and a special class **conjunctions**, a.o.
- Crucially, our μ and κ markers are such words.
- When alternatives are active, **exhaustification is obligatory**.

BACK TO ENGLISH DISJUNCTION: A SKETCH

- Turning back to the English facts: disjunction is inherently implicative may yield
  - an **ignorance implicature**, or
  - a **scalar implicature** (SI).

(5) **Mary saw John or** (Mary saw) **Bill.**

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- We focus on the SI.
- There are two ways of calculating the SI and deriving the exclusive component:
  - locally
  - globally

(A) GLOBAL CALCULATION

- GLOBAL CALCULATION of the exclusive component via $\mathfrak{X}_{[\sigma\mathfrak{A}]}$

i. Syntactic structure (simplified):

ii. Logical form:
$\mathfrak{X}_{[\sigma\mathfrak{A}]}(j \vee b) = [j \vee b] \wedge \neg[j \wedge b]$

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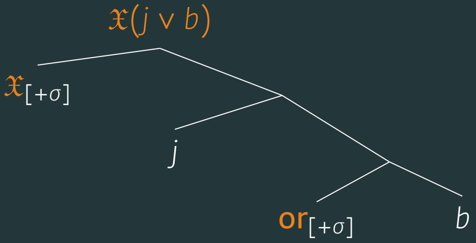

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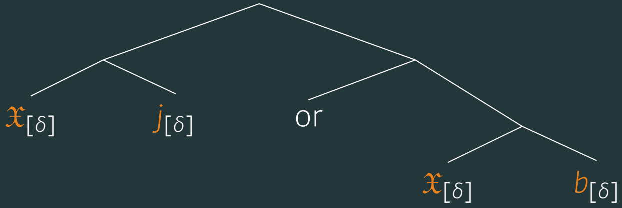

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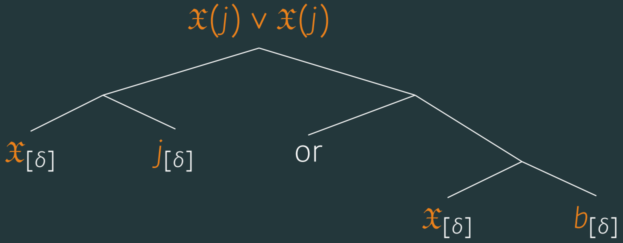

$\mathfrak{X}(j) \vee \mathfrak{X}(j)$

$\mathfrak{X}_{[\delta]}$

$j_{[\delta]}$

or

$\mathfrak{X}_{[\delta]}$

$b_{[\delta]}$

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THE MEANINGS OF SUPERPARTICLES

- We now propose two lexical entries for the two superparticles μ and κ, and the Junction head which forms coordination.
- Syntactically, we take the view that conjunction and disjunction are both part of a **junction structure** (JP) with an abstract Junction head.

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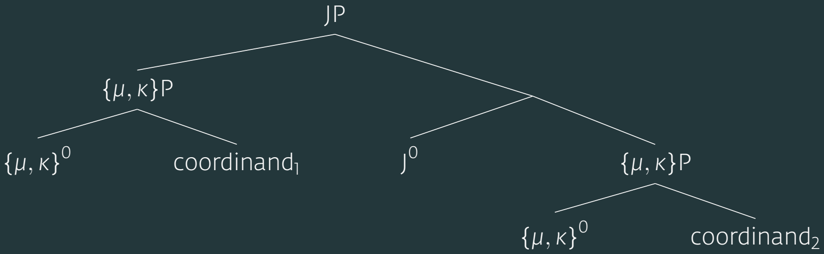

THE MEANINGS

- We assume that μ, κ, and J have the following meanings (very generally, see Mitrović 2014 for details):

μ
  - $[\![\mu]\!](p) = \mathfrak{X}(\mathfrak{X}(p)) = \neg\mathfrak{X}p$

κ performs inquisitive closure
  - $[\![\kappa]\!](p) = p \vee \neg p = \{p, \neg p\}$

J

EVIDENCE & PUZZLE

THE PUZZLING EVIDENCE

- We now turn to the actual problem at hand and present fresh data where both μ and κ markers are used to build XOR words.
- We propose and defend two generalisation.

(6) a. GENERALISATION 1
Disjunction markers (κ-class) tend to feature in morphologically more complex expression than the conjunction markers (μ-class) do.

b. GENERALISATION 2
Morphologically complex disjunction markers may include the conjunction markers (μ-class).

SO MANY PARTICLES IN SO MANY LANGUAGES

- Evidence from **seven languages** (five language families) supports this:
    - Homeric Greek (†)
    - Hittite (†)
    - Tocharian (†)
    - Slavonic (Ser-Bo-Croatian)
    - NE Caucasian (Avar, Dargi)
- I now turn to buttressing these facts.

EVIDENCE & PUZZLE

THE CORE DATA

HOMERIC GREEK

(7) **ē-t(e)** ehremen para soi
κ-μ keep with self

'...or [else] to keep with yourself' (Il. T. 148)

(8) **ei-te** boulesthe polemein emin **ei-te** filoi
κ-μ wish to be at war for myself *κ-μ* friend
einai
be

'whether you wish to wage war upon us or [else] to be our friends'

(Cyrop. 3.2.13.)

HITTITE

(9) nu-šši **naššu** adanna peškezzi **naš-ma**-šši
now-him $\kappa^{?}$-(μ) =either eat give $\kappa^{?}$-μ-him
akuwanna peškezzi
drink give

'He either gives him to eat or he gives him to drink'
(KUB 13.4 i 24)

(10) LU$_{\text{LU}}$=**ku** GUD=**ku** [UD]U=**ku** ēšzi
human being-(κ+)μ ox-(κ)-μ [she]ep-(κ)-μ be

'...whether it be human being, ox or [she]ep.'

(KBo 6.3 iv 53)

TOCHARIAN

(11) **pe** klośäm nāñi
μ ears.DU 1.GEN
'also my ears' (TA 5: 53, b3/A 58b3 in Zimmer 1976, 90)

(12) ckācar **e-pe** śäm **e-pe**
sister *κ-μ* wife *κ-μ*
'(either) sister or wife' (TA 428: a4, b2; Carling 2009, 74)

SLAVONIC (SER-BO-CROATIAN)

(13) **i** Mujo **i** Haso
μ M *μ* H
'**Both** Mujo **and** Haso.'

(14) **i-li** Mujo **i-li** Haso
μ-κ M *μ-κ* H
'**Either** Mujo **or** Haso.'

NE CAUCASIAN: DARGI

(15)

nu-ni	umx u	sune-la	mer.li-či-b	b-arg-i-ra,
me-ERG	key(ABS)	self-GEN	place-SUP-N	N-find-AOR-1

amma	**ya**	pulaw,	**ya**	'är'ä	he-d-arg-i-ra
but	*κ*	pilaf(ABS)	*κ*	hen(ABS)	NEG-PL-find-AOR-1

'I found the key at its place, but n**either** the pilaf n**or** the chicken was there.' (van der Berg 2004, 203)

(16)

il.a-la	buruš	**ra**	yurgan	**ra**	'änala
this-GEN	mattress(ABS)	*μ*	blanket(ABS)	*μ*	pillow(ABS)

ra	kas-ili	sa⟨r⟩i
μ	take-GER	be.PL

'(They) took his mattress, blanket **and** pillow.'

(van der Berg 2004, 199)

NE CAUCASIAN: DARGI

(17)	**ya**	**ra**	pilaw	b-ir-ehe,	**ya**	**ra**	nerg	b-ir-ehe
	κ	μ	pilaf(ABS)	N-do-FUT.1	κ	μ	soup(ABS)	N-do-FUT.1

('What shall we make for lunch?') 'We'lll make (either) pilaf or soup.' (van der Berg 2004, 204)

NE CAUCASIAN: AVAR

(18) keto **gi** hve **gi**
cat *μ* (J) dog *μ*
'cat and dog' (Avar; Ramazanov, p.c.)

(19) **ya gi** Sasha **ya gi** Vanya
κ *μ* S (J) *κ* *μ* V
'either Sasha or Vanya.' (Avar; Mukhtareva, p.c.)

EVIDENCE & PUZZLE

SUMMA SUMMARUM

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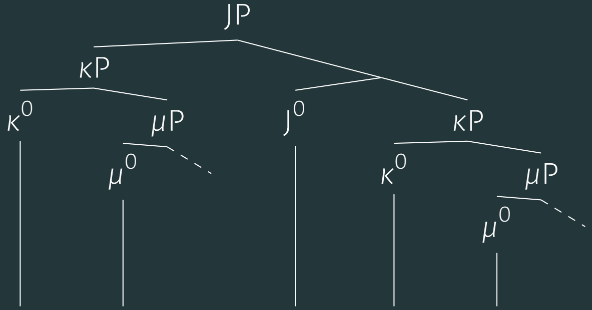

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ANALYSIS: STRUCTURE & CALCULATION

THE STRUCTURE & THE THEOREM THAT THE DATA SUGGEST

a. $\left[_{\mathrm{JP}^+}\ \beta^0_{[\mathrm{F}:\kappa]}\ \left[_{\mathrm{JP}}\left[_{\kappa\mathrm{P}_1}\ \kappa^0_1\ [_{\mu\mathrm{P}_1}\ \mu^0_1\ \ \mathrm{XP}]]\left[\mathrm{J}^0\ [_{\kappa\mathrm{P}_2}\ \kappa^0_2\ [_{\mu\mathrm{P}_2}\ \mu^0_2\ \mathrm{YP}]]\right]\right]\right]$

b. $\bigsqcup\left(\llbracket \mathrm{J}^0 \rrbracket\left(\llbracket \kappa^0_1 \rrbracket\left(\llbracket \mu^0_1 \rrbracket(\llbracket \mathrm{XP} \rrbracket)\right)\right)\left(\llbracket \kappa^0_2 \rrbracket\left(\llbracket \mu^0_2 \rrbracket(\llbracket \mathrm{YP} \rrbracket)\right)\right)\right)$

c. THEOREM. (b) $\vdash \llbracket \mathrm{XP} \rrbracket \vee \llbracket \mathrm{YP} \rrbracket \wedge \neg(\llbracket \mathrm{XP} \rrbracket \wedge \llbracket \mathrm{YP} \rrbracket)$

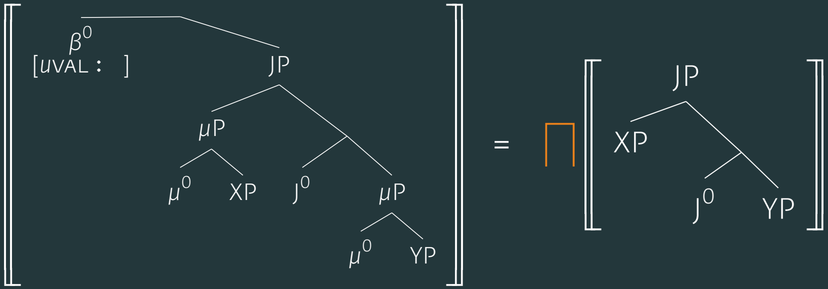
ANALYSIS: STRUCTURE & CALCULATION

PREJACENT MEANING

DETERMINING THE PREJACENT: SIMPLEX μ-CONTEXTS

- We assume the prejacent is determined at JP^{+} level, by virtue of minimality alone. (cf. Chierchia 2013)

(20) Syntactically rooted MEET:



$$= \sqcap \langle [\![XP]\!], [\![YP]\!] \rangle$$

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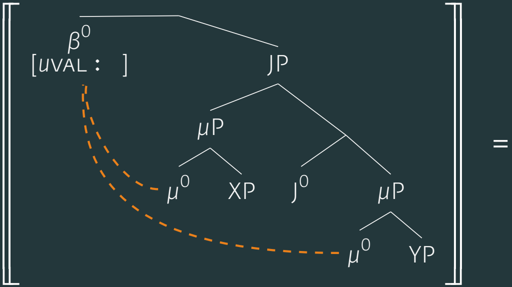

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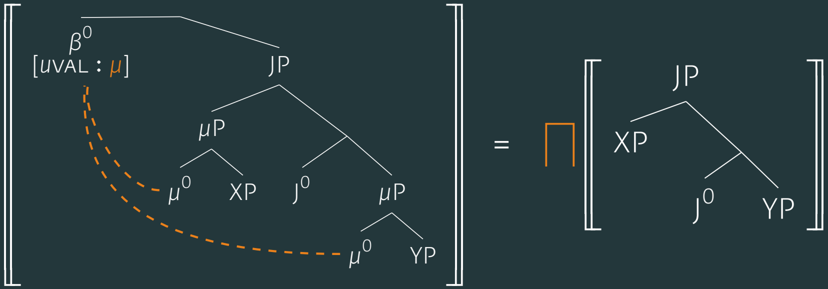

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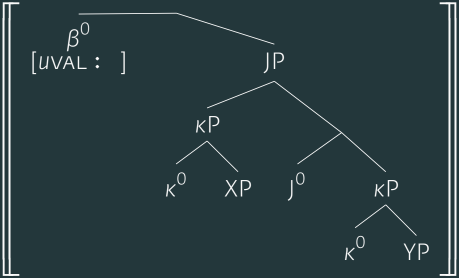
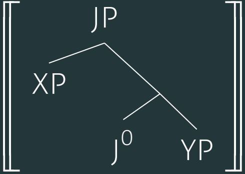
(21) Syntactically rooted JOIN:



$=\ \bigsqcup$



$$= \sqcup \langle [\![XP]\!], [\![YP]\!] \rangle$$

$$= \vdash [\![XP]\!] \vee [\![YP]\!]$$

DETERMINING THE PREJACENT: SIMPLEX κ-CONTEXTS

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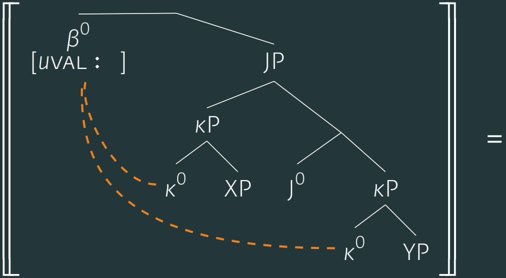

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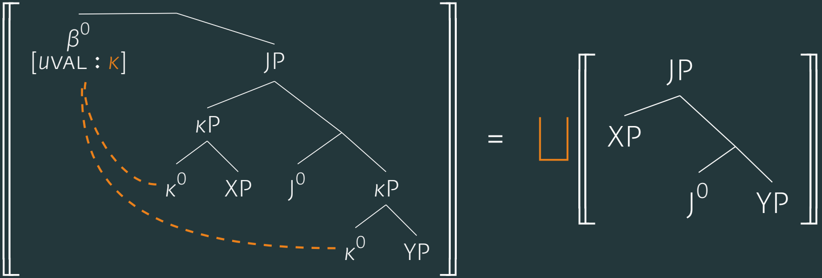

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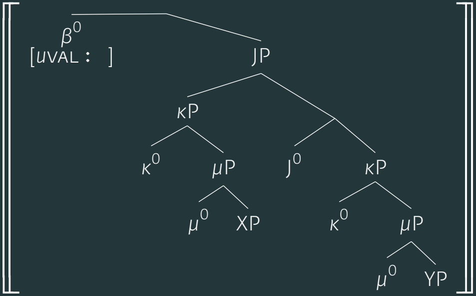
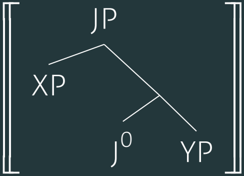
DETERMINING THE PREJACENT: COMPLEX $\kappa + \mu$-CONTEXTS

- Let $[\![\mathrm{JP}^{+}_{\kappa+\mu}]\!] = \bigcap\{$PREJACENT, ASSERTION/IMPLICATURE$\}$
- β-VALUATION determines primary meaning/prejacent.

(22) Syntactic competition for **valuation**:



$= \bigsqcup$



$= \sqcup\langle[\![\mathrm{XP}]\!], [\![\mathrm{YP}]\!]\rangle$

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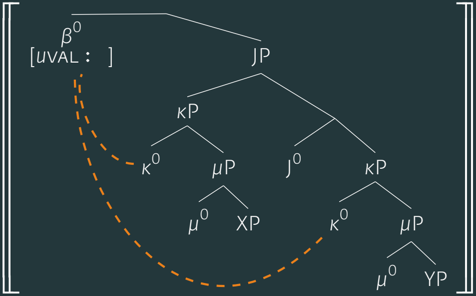

=

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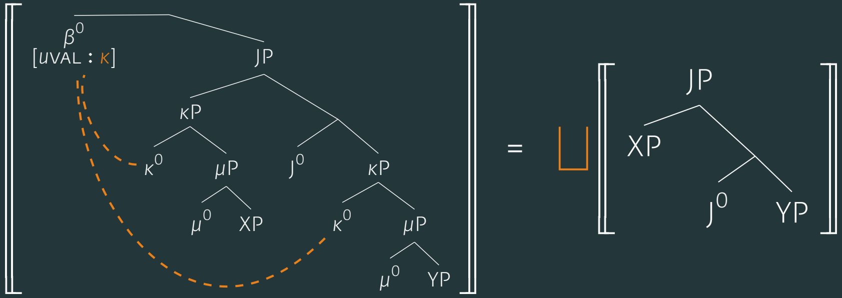

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AN ALLOSEMIC VIEW OF JUNCTION MEANING

- We derived a technical apparatus which deliver the allosemy J.
- We take the necessary configuration for a singly cyclical domain of spell-out to be constrained to a maximal projection, namely JP to the root of which β attaches.

(23) For a pair of coordinands (juncts) XP and YP denoting φ and ψ, respectively, the Boolean value of $[_{JP}\ \mathrm{XP}\ [\ \mathrm{J}^0\ \mathrm{YP}\ ]]$ to be structurally conditioned:

a. $[\![\mathrm{JP}]\!] \Leftrightarrow \varphi \wedge \psi$ /

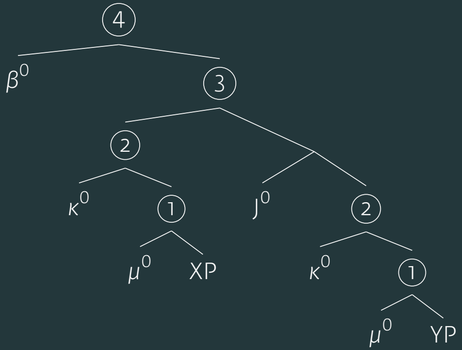
b. $[\![\mathrm{JP}]\!] \Leftrightarrow \varphi \vee \psi$ /

NAVIGATION

ANALYSIS: STRUCTURE & CALCULATION

GENERATING ALTERNATIVES

THE COMPOSITION



① $[\![\mu P]\!]$ as FA of $[\![\mu^0]\!]$ and its argument (coordinand)

② $[\![\kappa P]\!]$ as FA of $[\![\kappa^0]\!]$ and $[\![\mu P]\!]$

③ $[\![JP]\!]$ as tuple-forming FA of $[\![J^0]\!]$ and two $[\![\kappa P]\!]$s (structural coordinands)

④ $[\![JP^+]\!]$ as FA of $[\![\beta^0]\!]$ and $[\![JP]\!]$

EXCURSUS: THE ♡-PROCEDURE

- Our alternative set will grow widely.
- We therefore require a system(at)ic procedure that will **prevent inconsistent alternative (sub)sets**.
- The procedure we appeal to is that of **Innocent Exclusion** (♡)

(24) $\mathfrak{X}(\mathfrak{A}_{\langle\langle s,t\rangle,t\rangle})(p)(w) \Leftrightarrow p(w) \wedge \forall q[q \in \heartsuit(p,\mathfrak{A}) \rightarrow \neg q(w)]$

(Fox, 2007, 26)

HURFORD'S CONSTRAINT & ♡

(25) HURFORD'S CONSTRAINT (HC)
Neither of the disjuncts should entail the other, or each other.

a. a disjunction of the form $X_1 \vee X_2$ is odd if X_1 entails X_2, or vice versa (Katzir and Singh, 2013, 202)

b. $p \vee q = \begin{cases} \bot & \text{if } p \vdash q \text{ or } q \vdash p \\ \neg\bot & \text{otherwise} \end{cases}$

- We take HC-violating alternatives to be ♡-excludable.

STEP 1

- The meaning of μP

(26) a. First layer of exhaustification:

$$\begin{aligned} \mathfrak{X}(p)(\{p\}) &= p \wedge \neg p \\ &\vdash \bot \end{aligned}$$

b. Second layer of exhaustification:

$$\begin{aligned} \mathfrak{X}(p)\Big(\{\mathfrak{X}(p)\}\Big) &= p \wedge \neg \mathfrak{X}(p) \\ &\nvdash \bot \end{aligned}$$

- For details and further arguments for iterativity of $\mathfrak{X}$, see Sauerland 2004, Fox 2007 and Mitrović and Sauerland 2014, *inter. al.*.

STEP 2

- The meaning of κP as saturated by μP

(27) Composing κP:

$$
\begin{array}{rcl}
[\![\kappa\text{P}]\!] & = & [\![\kappa^{0}]\!]\big([\![\mu\text{P}]\!]\big) \\
 & = & \lambda p[p \vee \neg p]\Big([p \wedge \neg \mathfrak{X}(p)]\Big) \\
 & = & [p \wedge \neg \mathfrak{X}(p)] \vee \neg[p \wedge \neg \mathfrak{X}(p)] \\
\text{(by DeM)} & = & [p \wedge \neg \mathfrak{X}(p)] \vee [\neg p \vee \mathfrak{X}(p)] \\
 & = & \Big\{[p \wedge \neg \mathfrak{X}(p)], [\neg p \vee \mathfrak{X}(p)]\Big\} \\
 & = & \Big\{\{[p \wedge \neg \mathfrak{X}(p)]\}, \Big\{\{\neg p\}, \{\mathfrak{X}(p)\}\Big\}\Big\}
\end{array}
$$

STEP 3

- We now pair up the two complex κPs:

(28) Composing JP:

$$
\begin{array}{rcl}
[\![\text{JP}]\!] & = & [\![\text{J}^0]\!]\Big([\![\kappa\text{P}_1]\!]\Big)\Big([\![\kappa\text{P}_2]\!]\Big) \\
\text{(by Lex. it.)} & = & \lambda y \lambda x[x \bullet y]\Big([\![\kappa\text{P}_1]\!]\Big)\Big([\![\kappa\text{P}_2]\!]\Big) \\
\text{(by FA)} & = & [\![\kappa\text{P}_1]\!] \bullet [\![\kappa\text{P}_2]\!] \\
 & = & \langle [\![\kappa\text{P}_1]\!], [\![\kappa\text{P}_2]\!] \rangle \\
 & = & \langle [[p \wedge \neg\mathfrak{X}(p)] \vee [\neg p \vee \mathfrak{X}(p)]], [[q \wedge \neg\mathfrak{X}(q)] \vee [\neg q \vee \mathfrak{X}(q \\
\text{(by AO)} & = & \left[\left\{\{[p \wedge \neg\mathfrak{X}(p)]\}, \Big\{\{\neg p\}, \{\mathfrak{X}(p)\}\Big\}\right\}\right] \\
\text{(by AO)} & = & \left\langle \left[\left\{\begin{matrix}\{[p \wedge \neg\mathfrak{X}(p)]\}, \\ \{\{\neg p\}, \{\mathfrak{X}(p)\}\}\end{matrix}\right\}\right], \left[\left\{\begin{matrix}\{[q \wedge \neg\mathfrak{X}(q)]\}, \\ \{\{\neg q\}, \{\mathfrak{X}(q)\}\}\end{matrix}\right\}\right] \right\rangle
\end{array}
$$

STEP 4

- The JP-pair is mapped onto disjunction (as per β-valuation)

(29) Composing JP^{+}:

$$
\begin{array}{rcl}
[\![\mathrm{JP}^{+}]\!] & = & [\![\beta^{0}]\!]\Big([\![\mathrm{JP}]\!]\Big) \\
\text{(by F-check.)} & = & \lambda\langle x, y\rangle\,[x \vee y]\Big(\,\langle[\![\kappa\mathrm{P}_1]\!], [\![\kappa\mathrm{P}_2]\!]\rangle\,\Big) \\
\text{(by FA)} & = & \langle[\![\kappa\mathrm{P}_1]\!], [\![\kappa\mathrm{P}_2]\!]\rangle \\
 & = & [\![\kappa\mathrm{P}_1]\!] \vee [\![\kappa\mathrm{P}_2]\!] \\
 & = & \left[\left\{\begin{array}{l}\{[p \wedge \neg\mathfrak{X}(p)]\}, \\ \left\{\{\neg p\}, \{\mathfrak{X}(p)\}\right\}\end{array}\right\}\right] \vee \left[\left\{\begin{array}{l}\{[q \wedge \neg\mathfrak{X}(q)]\}, \\ \left\{\{\neg q\}, \{\mathfrak{X}(q)\}\right\}\end{array}\right\}\right] \\
\text{(by AO)} & = & \left\{\left\{\begin{array}{l}\{[p \wedge \neg\mathfrak{X}(p)]\}, \\ \left\{\{\neg p\}, \{\mathfrak{X}(p)\}\right\}\end{array}\right\}, \left\{\begin{array}{l}\{[q \wedge \neg\mathfrak{X}(q)]\}, \\ \left\{\{\neg q\}, \{\mathfrak{X}(q)\}\right\}\end{array}\right\}\right\}
\end{array}
$$

WHAT WE END UP WITH

- Once we 'flatten' the generated alt-set, we end up with the following:

$$\bar{\mathfrak{A}} = \{[p \wedge \neg\mathfrak{X}(p)], [q \wedge \neg\mathfrak{X}(q)], [\neg p], [\neg q], [\mathfrak{X}(p)], [\mathfrak{X}(q)]\}$$

A CLEANER VERSION OF RESULT

- The alternative set $\bar{\mathfrak{A}}$ is inconsistent.
- We impose the $\heartsuit$-function which negates an optimal amount of alternative subsets until consistency obtains.

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A CLEANER VERSION OF RESULT

- The alternative set $\bar{\mathfrak{A}}$ is inconsistent.
- We impose the ♡-function which negates an optimal amount of alternative subsets until consistency obtains.
- The resulting maximally consistent subsets are:

(30) $[\![\mathrm{JP}^{+}]\!] = \left\{ \begin{array}{ll} [p \wedge \neg \mathfrak{X}(p)], & [\neg p \vee \mathfrak{X}(p)], \\ [q \wedge \neg \mathfrak{X}(q)], & [\neg q \vee \mathfrak{X}(q)] \end{array} \right\}$ . . . . . ⊢ ¬CONS

a. $\big\{[p \wedge \neg \mathfrak{X}(p)], [q \wedge \neg \mathfrak{X}(q)]\big\}$ . . . . excludable: HC

b. $\big\{[\neg p \vee \mathfrak{X}(p)], [\neg q \vee \mathfrak{X}(q)]\big\}$

   i. $\{\{\neg p\}, \{\neg q\}\}$ . . . . excludable: ∃C

   ii. $\{\{\mathfrak{X}(p)\}, \{\mathfrak{X}(q)\}\}$ . . . . ✓

CONCLUSION

- I tried making sense out of complex morphology for, what seems to be, a rather simple meaning of 'or' or 'v'.
- I have not only shown that five operators (heads) are present in the morphosyntactic expression of exclusive disjunction, but have also presented an analysis of deriving the exclusive component as a computational consequence of five-head/operator composition ($1 \times \text{J}^0, 2 \times \kappa^0, 2 \times \mu^0$) and alternative elimination via a ♡-like procedure (including HC) that handles inconsistencies in the generated alternative set.
- This is a sincere attempt to elucidate the compositional gymnastics of logical units below the word level without compromising either the morphosyntax or the semantics.

THANK YOU!

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