CCG for Discourse

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Proposal

- **Categories of questions and focus:**

  Functions from a sentence to another sentence in view of their semantics

- **CCG for discourse:**

  Question-answer pair can be combined by functional application.

Combinatory Categorial Grammar

(Ajdukiewicz 1935, Bar-Hillel 1953, Szabolcsi 1987, Steedman 2000)

(1) Ana met Boris.

Ana met Boris.

"Ana met Boris."

$\underline{\text{Ana}}_{\text{Lex}}$ $\underline{\text{met}}_{\text{Lex}}$ $\underline{\text{Boris}}_{\text{Lex}}$

NP: a (NP\S)/NP: λx,y.meet(x)(y) NP: b$_{>}$

NP\S: λy.meet(b)(y)$_{<}$

S: meet(b)(a)

SOV language

(2) Ana-wa Boris-ni atta.

Ana-TOP Boris-DAT met

"Ana met Boris."

$\underline{\text{Ana}}_{\text{Lex}}$ $\underline{\text{Boris}}_{\text{Lex}}$ $\underline{\text{atta}}_{\text{Lex}}$

NP: a NP: b NP\(NP\S): λx,y.meet(x)(y)$_<$

NP\S: λy.meet(b)(y)$_<$

S: meet(b)(a)

Combinators

- Functional application >, <

X/Y	Y	$=>_>$	X
:λx.f(x)	:a		:f(a)
X	X\Y	$=>_<$	Y
:a	:λx.f(x)		:f(a)

- Functional composition >B, <B

X/Y	Y/Z	$=>_B$	X/Z
:f	:g		:λx.f(g(x))
X\Y	Y\Z	$=>_B$	X\Z
:f	:g		:λx.g(f(x))

What is the category of Japanese sentence-final particles?

(3) Rie-wa Chikara-ni atta-**yo**.
Rie-TOP Chikara-DAT met-PAR
"Rie met Chikara."

(4) Rie-wa Chikara-ni atta-no-**ka**?
Rie-TOP Chikara-DAT met-PAR
"Did Rie meet Chikara?"

(5) Rie-wa Chikara-ni atta-**no**?
Rie-TOP Chikara-DAT met-PAR
"Did Rie meet Chikara?"

(6)

Ana$_{Lex}$ Boris$_{Lex}$ atta$_{Lex}$ yo$_{Lex}$

NP: a NP: b (NP\S)/NP: λx,y.meet(x)(y)$_<$ **?**

NP\S: λy.meet(b)(y)$_<$

S: meet(b)(a)

Proposal

- *Yo* and certain types of *ne* as verum, or polarity focus operators (Höhle 1992, Romero & Han 2004)
- *Ka*, *no*, *ne*, *na*, *k*e, and *kashira* as question markers.
- Given such semantics, their categories are S\(S/S).
- No need for modalities
- Syntax and semantics correspondence

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Steedman (2000): Prosodically Annotated Categories

- CCG: questions, focused sentences, exclamatives

: S (sentence)

Steedman (2000)

features: theme・rheme values

(7) ate := (NP\S)/NP: ate'

theme ate := $(S_\theta/NP_\theta)/NP_\theta$: *ate'

L+H*

rheme ate := $(S_\rho/NP_\rho)/NP_\rho$: *ate‘

H*

Barker and Shan (2006)

Multi-modal TLG

- who, what, whose |- (np\$_?$S)/(np\S).
- a single-wh question np\$_?$s

  e.g., What did you see?

Jäger (2005)

- Questions: q
- Wh-words (what, who): q/(np↑s)

Hockenmaier&Steedman (2007)

- S carries a feature that distinguishes sentence types:

  declaratives (S[dcl])

  wh-questions (S[wq])

  yes–no questions (S[q])

  fragments (S[frg])

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Mismatch with Semantics

- Questions:

  Sets of possible answers (Hamblin 1973).

- Focus:

  Pragmatically induces a set of alternatives (Rooth 1985,1992).

Hamblin (1973)

- A question is a set of possible answers in a given context

(8) [|Did you see Alice?|] =

{you saw Alice, you did not see Alice}

- A proposition:

a set of possible worlds <s, t>

- A set of possible answers

a set of sets of possible worlds <s, <st, t>>

Kartunnen (1977)

- A question is a set of true answers (Kartunnen 1977)

(9) [|Who will come to dinner tonight?|]

= λp.$\exists$x.[p=λw.come-to-dinner(w)(x) & p(w)]

Rooth (1985, 1992)

- Focus induces sets of alternative propositions.

(9) A: Where did you go on weekend?

B: I went to the BEACH.

(10) [| I went to the BEACH |]^{f}

= {I went shopping, I went hiking, I stayed home,...}

(11) [| I went to the BEACH |]^{o}

= I went to the beach

Direct Compositionality

- The syntax and the semantics work together in tandem.
- Every expression that is computed in syntax has meaning (Jacobson 2002, Barker&Jacobson 2007).
- The semantic type of questions and focused sentences <s, <st, t>> more straightforwardly correspond to type S/S rather than S_Q or S_{FOC}

Proposal

(12) A polar question: S/S: {p, ¬p}

A focused sentence: S/S: {p, q, r,...}

CCG for Discourse

- Such novel categories adequately handle discourse:*

(13) A: Who came?

B: Mary came.

$\underline{who}_{Lex}$	$\underline{came}_{Lex}$?	$\underline{Mary}_{Lex}$	$\underline{came}_{Lex}$
(S/S)/(NP\S)	NP\S	NP	NP\S

$\underline{:\lambda g,q[q=\lambda w.[g(m)(w)\vee g(a)(w) \vee g(b)(w)]]\ :\lambda w,x.came(x)_{>}}\ \underline{:m\ :\lambda w,x.came(x)(w)_{<}}$

$\underline{S/S:\ \lambda w,q[q=\lambda w.came(m)(w)\vee came(a)(w)\vee\ came(b)(w)]\quad S:\ \lambda w.came(m)(w)_{>}}$

S: $\underline{\lambda w.[came(m)=came(m)\vee came(a)\vee came(b)]}$

What about Question to Question Response?*

(14) Presupposition Failure

Did Mary come? Who is Mary?

S/S: S/S :

$\lambda w,q.[q=\lambda w.came(m)(w) \vee \neg came(m)(w)]$

$\lambda w,q.[q=\lambda w.be(a)(m)(w) \vee be(b)(m)(w) \vee be(j)(m)(w)]_{>B}$

S/S: $\lambda w,q.[q=came(m) \vee \neg came(m) \vee be(a)(m) \vee be(b)(m) \vee be(j)(m)]$

Mary-Jane

S: $be(j)(m)_{>}$

S: $\lambda w[be(j)(m)=came(m) \vee \neg came(m) \vee be(a)(m) \vee be(b)(m) \vee be(j)(m)]]$

Groenendijk and Stokhof (1984, 1997)

- A question combines with a fragment answer, not a full sentence.
- Fragmental answers are propositions.

- cf. Stainton: fragments undergo semantic ellipsis

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Syntactic Behavior

- Japanese is a SOV language
- Sentence-final particles may attach either to a verb, a modal, a tense marker, which fall in the end of sentences.
- Ungrammatical elsewhere other than the sentence-final position except for *ne* and *na* which may attach to a case marker such as the nominative marker *ga*.

(15) a. So-da-yo.
so-be-PAR
``That's right, isn't it?"

b. (*Yo)-so-(*yo)-da.
PAR-so-PAR-be
``That's right, isn't it?"

(16) a. Ken-ga hanashi-ta-rashii-ne.
Ken-NOM speak-PASTEVI-PAR
``It seems Ken has spoken, hasn't he?"

b. Ken-ga hanashi-(*ne)-ta-(*ne)-rashii.
Ken-NOM speak-PAR-PAST-PAR-EVI
``It seems Ken has spoken, hasn't he?"

c. Ken-ga-ne hanashi-ta-rashii.
Ken-NOM-PAR speak-PAST-EVI
``It seems Ken has spoken, hasn't he?"

(17)a. O-namae-wa nan-deshi-tak-ke.
HON-name-TOP what-HON-PAST-PAR
``What was your name?"

b. O-namae-wa (*ke)-nan-(*ke)-deshi-(*ke)-ta.
HON-name-TOP PAR-what-PAR-HON-PAR-PAST
``What was your name?"

Previous Literature

- So far not much formal descriptions
- Masuoka&Takubo (1992): descriptive meaning
- Chino (2001): pedagogical view
- Takubo&Kinsui (1997): information-sharing
- McCready (2007): dynamic semantics and relevance theory

My Analysis

- Japanese sentence-final particles are mostly question or exclamative markers.
- In harmony with their syntactic position, semantically speaking, the sentence-final particles take a proposition as the argument and returns a set of propositions.

particle	Masuoka-Takubo (1992)	Chino (2001)	my proposal	category	terms
ka	question		a question marker/ an exclamative marker	S\(S/S)	$\lambda p_{<st>}.\lambda w_{<s>}.\lambda q_{<st>}[q = p \vee q = \neg p]$
no		question/ command	question marker or a polarity focus marker (Höhle 1992, Romero & Han 2004).	S\(S/S) or S\S	$\lambda p_{<st>}.\lambda w_{<s>}.\lambda q_{<st>}[q = p \vee q = \neg p]$ or $\lambda p_{<st>}.\lambda w.\forall w' \in Epi_x(w)[p(w') = 1]$
ne	agreement/affirmation	admiration/ agreement/ request softener	a tag question marker	S\(S/S)	$\lambda p_{<st>}.\lambda w_{<s>}.\lambda q_{<st>}[q = p \vee q = \neg p]$

particle	Masuoka-Takubo (1992)	Chino (2001)	my proposal	category	terms
yo	notification /alert, warning	urges a course of action/ request/ certainty	a polarity focus marker	S\S	$\lambda p_{<st>}.\lambda w_{<s>}.\forall w' \in Epi_x(w)[p(w') = 1]$
na	confirmation, agreement	indicates emotion/ asks for agreement	a question marker or an exclamative marker	S\(S/S)	$\lambda p_{<st>}.\lambda w_{<s>}.\lambda q_{<st>}[q = p \vee q = \neg p]$

particle	Masuoka-Takubo (1992)	Chino (2001)	my proposal	category	terms
ke	confirm memory	question for recalling shared information	a question marker	S\(S/S)	$\lambda p_{<st>}.\lambda w_{<s>}.\lambda q_{<st>}[q = p \vee q = \neg p]$
kashira		uncertainty / question/ request	a question marker	S\(S/S)	$\lambda p_{<st>}.\lambda w_{<s>}.\lambda q_{<st>}[q = p \vee q = \neg p]$

Functions from a proposition to a set of propositions

- Semantically, these particles are functions from a proposition to a set of propositions.
- *No* as a question marker is a function from a proposition to a set of possible answers in a given context (Hamblin 1973).

(18) Arisu-o mi-ta-no.
Alice-ACC watch-PAST-PAR
``Did you see Alice?"

[| Did you see Alice?|] = {you saw Alice, you did not see Alice}

- The semantic type of sentence-final particles
  <st, <st, t>>

  more straightforwardly correspond to type S\(S/S)

  rather than $S\backslash S_Q$ or $S\backslash S_{FOC}$

  even though there is no syntactic composition of two sentences.

Meaning of *No*

Disambiguated by prosody

- A question marker
- A polarity (verum) focus marker

  Similar to *really* or *indeed* in English,

  The speaker assures the affirmative answer

  (Höhle 1992, Romero&Han 2004)

(19) A. Nani-o shi-teru-**no**?
what-ACC do-PROG-**Q**
``What are you doing?"

B. Hon-o yon-deru-**no**.
book-ACC read-PROG-**FOC**
``I am reading a book

A: Hon-o yon-deru-**no**?
book-ACC read-PROG-**Q**
``Are you reading a book?"

B: So. Hon-o yon-deru-**no**.
yes book-ACC read-PROG-**FOC**
``Yes, I am reading a book."

A: Nani-o yon-deru-**no**?
what-ACC read-PROG-**Q**
``What are you reading?"

CCG Trees
No as a Focus Marker

(20)a.

	Hon-o$_{Lex}$	yonderu$_{Lex}$	
∅ $_{Lex}$	NP$_{ACC}$: εx.book'	TVP: λxλy.read'(x)(y)	<
NP$_{NOM}$: s	VP: λy.read'(εx.book')(y)		<
S: read'(εx.book')(s)	S/S:λp$_{<st>}$.λw.∀w'∈wRw'[p(w') = 1]		<

S: λw$_{<s>}$.∀w'∈wRw'[read'(εx.book')(h)(w')=1]

(R: epistemic accessibility relation)

No as a Question Particle

b.

	Hon-o$_{Lex}$	yonderu$_{Lex}$	
$\varnothing_{Lex}$	NP$_{ACC}$: εx.book'	TVP: $\lambda x \lambda y$.read'(x)(y)	$<$
NP$_{NOM}$: h	VP: λy.read'(εx.book')(y)		$<$ no$_{Lex}$
S: read'(εx.book')(h)		S\(S/S): $\lambda p_{<st>}.\lambda w_{<s>}.\lambda q_{<st>}[q = p \vee q = \neg p]$	$<$

S/S: $\lambda w_{<s>}.\lambda q_{<st>}$[q = read'($\varepsilon$x.book')(h) $\vee$ q = $\neg$ read'(εx.book')(h)]

(s:speaker, h:hearer)

Yo: Kinsui (1993) Two Usages

- *Kyoji* (teaching/notifying):

(21) A, hankachi-ga ochi-mashi-ta-yo.
oh handkerchief-NOM fall-HON-PAR
``Oh, you have dropped your handkerchief."

- *Chui* (alert):

(22) Omae-wa jukensei-da-yo.
you-TOP entrance-exam-taker-be-FOC
Terebi-o keshite benkyo-shi-nasai.
TV-ACC turn.off study-do-IMP
``You are preparing for an entrance exam. Turn off the TV and study."

Yo as a Polarity Focus Marker

Proposal

- Both usages of *yo* implicates that the hearer is supposed to know that *p* is true.
- The speaker emphatically demonstrates that s/he wants the hearer to accept the facts-that s/he dropped a handkerchief and s/he is before the exam

Belief Update

- Notifying *yo*:

(23) ¬Past(Believe(p)(s)) & Now(Believe(p)(s))

-Hearer now believes what s/he had not believed before.

- Alerting *yo*:

(24) Past(Believe(p)(s)) & Now(Believe(p)(s))

-Hearer has believed *p* from before

Na

- Masuoka&Takubo (1992):

  agreement or affirmation.

- Chino (2001):

  indicates emotion or asks for agreement.

Na as an Exclamative Marker or a Question Marker

Proposal:

- an exclamative marker
- a question marker
- an epistemic modal

(25) Sugoi ie-da-na.
gorgeous house-be-EXC
``What a gorgeous house!" (BCCWJ2009)

(26) Muri-ka-na.
impossible-Q-Q
``Will it be impossible?

Na as an Epistemic Modal

Chino (2001): *na* softens the effect of an assertion.

(27) 8-ji-kara 11-ji-da-na.
8-o'clock-from 11-o'clock-be-PAR
``From eight o'clock to 11 o'clock.''
(BCCWJ2009)

- Such uncertainty expressed by *no* makes us consider this type of *no* as an epistemic modal.

Sequential Particles: *No-ka*, *Yo-na*, *Yo-ne*

- More than one sentence-final particles may appear together although there are restrictions.

(28) So-dat-ta-no-ka.

so-be-PAST-PAR-PAR

``Was it so?"

(29) Kyo-wa i tenki-da-yo-na.

today-TOP good weather-be-PAR-PAR

``Isn't it good weather today?

Functional Composition

(30)

So_{Lex}	$datta_{Lex}$	no_{Lex}	ka_{Lex}
NP:a	NP\S:$\lambda w,x.be(x)_{<}$	S\(S/S):	S\(S/S):

S: be(a) $\lambda p_{<st>}.\lambda w_{<s>}.\lambda q_{<st>}[q = p \vee q = \neg p]$ $\lambda p_{<st>}.\lambda w_{<s>}.\lambda q_{<st>}[q = p \vee q = \neg p]$ **B**

S\(S/S): $\lambda p_{<st>}.\lambda w_{<s>}.\lambda q_{<st>}[q = p \vee q = \neg p]$

S/S: $\lambda w_{<s>}.\lambda q_{<st>}[q = be(a) \vee q = \neg be(a)]$

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Conclusion

- Questions and focused sentences are sets of propositions.
- Japanese sentence-final particles are polarity focus markers or question particles.
- CCG now handles discourse.