

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 Categorical Grammar

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

(1) Ana met Boris.

Ana met Boris.

“Ana met Boris.”

Ana_{Lex} met_{Lex} Boris_{Lex}

NP: a (NP\S)/NP: $\lambda x, y. \text{meet}(x)(y)$ NP: b_>

NP\S: $\lambda y. \text{meet}(b)(y)$ _<

S: meet(b)(a)

SOV language

(2) Ana-wa Boris-ni atta.

Ana-TOP Boris-DAT met

“Ana met Boris.”

Ana_{Lex} Boris_{Lex} atta_{Lex}

NP: a NP: b NP\ (NP\S): $\lambda x, y. \text{meet}(x)(y)$ _<

NP\S: $\lambda y. \text{meet}(b)(y)$ _<

S: meet(b)(a)

Combinators

- Functional application $>, <$

X/Y	Y	$\Rightarrow_>$	X
$:\lambda x.f(x)$	$:a$		$:f(a)$
X	$X \backslash Y$	$\Rightarrow_<$	Y
$:a$	$:\lambda x.f(x)$		$:f(a)$

- Functional composition $>B, <B$

X/Y	$Y/Z \Rightarrow_B$	X/Z
$:f$	$:g$	$:\lambda x.f(g(x))$
$X \backslash Y$	$Y \backslash Z \Rightarrow_B$	$X \backslash Z$
$:f$	$:g$	$:\lambda x.g(f(x))$

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: $\lambda x, y. \text{meet}(x)(y)$?

NP\S: $\lambda y. \text{meet}(b)(y)$

S: $\text{meet}(b)(a)$

Proposal

- *Yo* and certain types of *ne* as verum, or polarity focus operators (Höhle 1992, Romero & Han 2004)
- *Ka*, *no*, *ne*, *na*, *ke*, and *kashira* as question markers.
- Given such semantics, their categories are $S \backslash (S/S)$.
- 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_{θ}/NP_{θ})/NP $_{\theta}$: *ate'

L+H*

rheme ate := (S_{ρ}/NP_{ρ})/NP $_{\rho}$: *ate'

H*

Barker and Shan (2006)

Multi-modal TLG

- who, what, whose | - (np\?_iS)/(np\S).
- a single-wh question np\?_is
 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 $\langle s, t \rangle$
- A set of possible answers
a set of sets of possible worlds $\langle s, \langle st, t \rangle \rangle$

Karttunen (1977)

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

(9) [|Who will come to dinner tonight?|]
= $\lambda p. \exists x. [p = \lambda w. \text{come-to-dinner}(w)(x) \ \& \ p(w)]$

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 $\langle s, \langle st, t \rangle \rangle$ more straightforwardly correspond to type S/S rather than S_Q or S_{FOC}

Proposal

- (12) A polar question: $S/S: \{p, \neg p\}$
A focused sentence: $S/S: \{p, q, r, \dots\}$

CCG for Discourse

- Such novel categories adequately handle discourse:*

(13) A: Who came?

B: Mary came.

who_{Lex} came_{Lex}? Mary_{Lex} came_{Lex}

(S/S)/(NP\S)

NP\S

NP

NP\S

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

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

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

What about Question to Question Response?*

(14) Presupposition Failure

Did Mary come?

Who is Mary?

S/S:

S/S:

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

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

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

Mary-Jane

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

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

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)	$\lambda p_{\langle st \rangle} . \lambda w_{\langle s \rangle} . \lambda q_{\langle st \rangle} [q = p$ $\vee q = \neg p]$
no		question/ command	question marker or a polarity focus marker (Höhle 1992, Romero & Han 2004).	S\ (S/S) or S/S	$\lambda p_{\langle st \rangle} . \lambda w_{\langle s \rangle} . \lambda q_{\langle st \rangle} [q = p$ $\vee q = \neg p]$ or $\lambda p_{\langle st \rangle} . \lambda w . \forall w' \in Epi_x(w) [$ $p(w') = 1]$
ne	agreement/ affirmation	admiration/ agreement/ request softener	a tag question marker	S\ (S/S)	$\lambda p_{\langle st \rangle} . \lambda w_{\langle s \rangle} . \lambda q_{\langle st \rangle} [q = p$ $\vee q = \neg p]$

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	$\lambda p_{\langle st \rangle} . \lambda w_{\langle s \rangle} . \forall w' \in \text{Epi}_x(w)$ $[p(w') = 1]$
na	confirmation, agreement	indicates emotion/ asks for agreement	a question marker or an exclamative marker	S\((S/S)\)	$\lambda p_{\langle st \rangle} . \lambda w_{\langle s \rangle} . \lambda q_{\langle st \rangle} [q = p$ $\vee q = \neg p]$

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

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
 $\langle st, \langle st, t \rangle \rangle$
more straightforwardly correspond to type
 $S \backslash (S / S)$
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.

	<u>Hon-O</u> _{Lex}	<u>yonderu</u> _{Lex}	
$\emptyset$ _{Lex}	<u>NP_{ACC}: $\epsilon x.book'$</u>	<u>TVP: $\lambda x \lambda y.read'(x)(y)$</u>	_{<}
<u>NP_{NOM}: s</u>	<u>VP: $\lambda y.read'(\epsilon x.book')(y)$</u>	<u>no</u> _{Lex}	
<u>S: read'($\epsilon x.book'$)(s)</u>	<u>$S/S: \lambda p_{<st>}. \lambda w. \forall w'. w' \in wRw' [p(w') = 1]$</u>		_{<}
<u>S: $\lambda w_{<s>}. \forall w'. w' \in wRw' [read'(\epsilon x.book')(h)(w') = 1]$</u>			

(R: epistemic accessibility relation)

No as a Question Particle

b.

	<u>Hon-o</u> _{Lex}	<u>yonderu</u> _{Lex}
<u>∅</u> _{Lex}	<u>NP_{ACC}: ex.book'</u>	<u>TVP: λxλy.read'(x)(y)</u> _{<}
<u>NP_{NOM}: h</u>	<u>VP: λy.read'(ex.book')(y)</u> _{<}	<u>no</u> _{Lex}
<u>S: read'(ex.book')(h)</u>	<u>S\ (S/S): λp_{<st> . λw_{<s> . λq_{<st>} [q = p ∨ q = ¬p]}}</u> _{<}	
	<u>S/S: λw_{<s> . λq_{<st>} [q = read'(ex.book')(h) ∨ q = ¬ read'(ex.book')(h)]}</u>	

(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) $\neg \text{Past}(\text{Believe}(p)(s)) \ \& \ \text{Now}(\text{Believe}(p)(s))$

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

- Alerting yo :

(24) $\text{Past}(\text{Believe}(p)(s)) \ \& \ \text{Now}(\text{Believe}(p)(s))$

-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:λ_w,x.be(x)_< S\S/S): S\S/S):

S: be(a)

λ_{p<st>.}λ_{w<s>.}λ_{q<st>[q = p ∨ q = ¬p]} λ_{p<st>.}λ_{w<s>.}λ_{q<st>[q = p ∨ q = ¬p]} **B**

S\S/S): λ_{p<st>.}λ_{w<s>.}λ_{q<st>[q = p ∨ q = ¬p]}

S/S: λ_{w<s>.}λ_{q<st>[q = be(a) ∨ q = ¬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.