CCG for Discourse

Sumiyo Nishiguchi
School of Management
Tokyo University of Science

http://homepage3.nifty.com/sumiyo_nishiguchi/

September 29, 2011
TbILLC9, Kutaisi, Georgia
<table>
<thead>
<tr>
<th>1. Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Categories of Questions and Focus in CCG and TLG</td>
</tr>
<tr>
<td>3. Proposal: Higher Order for Questions and Polarity Focus</td>
</tr>
<tr>
<td>4. Categories of Sentence-final Particles in Japanese</td>
</tr>
<tr>
<td>5. Conclusion</td>
</tr>
</tbody>
</table>
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

(1) Ana met Boris.
Ana met Boris.
“Ana met Boris.”

\[
\begin{align*}
\text{Ana}_{\text{Lex}} & \quad \text{met}_{\text{Lex}} \quad \text{Boris}_{\text{Lex}} \\
\text{NP: } a & \quad \text{(NP}\backslash\text{S})/\text{NP: } \lambda x,y.\text{meet}(x)(y) & \quad \text{NP: } b > \\
\text{(NP}\backslash\text{S): } \lambda y.\text{meet}(b)(y) < & \\
\text{S: } \text{meet}(b)(a)
\end{align*}
\]
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: \text{meet}(b)(a)
Combinators

• Functional application >, <

\[
\begin{align*}
X/Y & \quad Y & \Rightarrow & \quad X \\
:\lambda x.f(x) & \quad :a & \quad :f(a) \\
X & \quad X\setminus Y & \Rightarrow & \quad Y \\
:a & \quad :\lambda x.f(x) & \quad :f(a)
\end{align*}
\]

• Functional composition >B, <B

\[
\begin{align*}
X/Y & \quad Y/Z \Rightarrow_B X/Z \\
:f & \quad :g & \quad :\lambda x.f(g(x)) \\
X\setminus Y & \quad Y\setminus Z \Rightarrow_B X\setminus Z \\
:f & \quad :g & \quad :\lambda x.g(f(x))
\end{align*}
\]
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) 

\[\text{Ana}_{\text{Lex}} \quad \text{Boris}_{\text{Lex}} \quad \text{atta}_{\text{Lex}} \quad \text{yo}_{\text{Lex}}\]

NP: a \quad NP: b \quad (NP\S)/NP: \lambda x,y.\text{meet}(x)(y) \quad \text{?}

______________________________________________________________

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

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
TABLE OF CONTENTS

1. Introduction

2. Categories of Questions and Focus in CCG and TLG

3. Proposal: Higher Order for Questions and Polarity Focus

4. Categories of Sentence-final Particles in Japanese

5. Conclusion
Steedman (2000): Prosodically Annotated Categories

- CCG: questions, focused sentences, exclamatives
  \[ S \text{(sentence)} \]

Steedman (2000)

features:  theme \· rheme values

(7) \[ \text{ate} := (\text{NP}\backslash S)/\text{NP}: \text{ate}' \]

\[ \begin{align*}
\text{theme} \quad \text{ate} := (S_\theta/\text{NP}_\theta)/\text{NP}_\theta: & \text{*ate}' \\
L+H^* & \\
\text{rheme} \quad \text{ate} := (S_\rho/\text{NP}_\rho)/\text{NP}_\rho: & \text{*ate}' \\
H^* &
\end{align*} \]
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])
# Table of Contents

1. Introduction  
2. Categories of Questions and Focus in CCG and TLG  
3. **Proposal: Higher Order for Questions and Polarity Focus**  
4. Categories of Sentence-final Particles in Japanese  
5. Conclusion
Mismatch with Semantics

• Questions:
  Sets of possible answers (Hamblin 1973).

• Focus:
Hamblin (1973)

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

(8)  \[ \{ | \text{Did you see Alice?} | \} = \{ \text{you saw Alice, you did not see Alice} \} \]

• 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)

\[ (9) \quad \left[ \left| \text{Who will come to dinner tonight?} \right| \right] = \lambda p. \exists x. [p = \lambda w. \text{come-to-dinner}(w)(x) \& p(w)] \]
Rooth (1985, 1992)

• Focus induces sets of alternative propositions.

(9) A: Where did you go on weekend?
    B: I went to the BEACH.

(10) \[ \{ I \text{ went shopping, I went hiking, I stayed home,} \ldots \} \]

(11) \[ \{ I \text{ went to the beach} \} \]

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, \neg 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.

\[ \text{who}_{\text{Lex}} \quad \text{came}_{\text{Lex}} \quad \text{Mary}_{\text{Lex}} \quad \text{came}_{\text{Lex}} \]

\[ (S/S)/(NP/S) \quad NP/S \quad NP \quad NP/S \]

\[ :\lambda g,q[q=\lambda w.[g(m)(w) \lor g(a)(w) \lor g(b)(w)]] :\lambda w,x.\text{came}(x) \quad :m :\lambda w,x.\text{came}(x)(w) \]

\[ S/S: \lambda w,q[q=\lambda w.\text{came}(m)(w) \lor \text{came}(a)(w) \lor \text{came}(b)(w)] \quad S: \lambda w.\text{came}(m)(w) \]

\[ S: \lambda w.[\text{came}(m)=\text{came}(m) \lor \text{came}(a) \lor \text{came}(b)] \]
What about Question to Question Response?

(14) Presupposition Failure

Did Mary come?   Who is Mary?

S/S:   S/S :

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

\[ \lambda w,q. [q=\lambda w.\text{be}(a)(m)(w) \lor \text{be}(b)(m)(w) \lor \text{be}(j)(m)(w)] \]

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

Mary-Jane

\[ \lambda w[\text{be}(j)(m)=\text{came}(m) \lor \neg \text{came}(m) \lor \text{be}(a)(m) \lor \text{be}(b)(m) \lor \text{be}(j)(m)] \]

S: \[ \lambda w[\text{be}(j)(m)=\text{came}(m) \lor \neg \text{came}(m) \lor \text{be}(a)(m) \lor \text{be}(b)(m) \lor \text{be}(j)(m)] \]
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
Table of Contents

1. Introduction
2. Categories of Questions and Focus in CCG and TLG
3. Proposal: Higher Order for Questions and Polarity Focus
4. Categories of Sentence-final Particles in Japanese
5. Conclusion
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.
so-be-PAR
``That's right, isn't it?"

b. (*Yo)-so-(*yo)-da.
PAR-so-PAR-be
``That's right, isn't it?"
Ken-NOM speak-PAST-EVI-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?"
   HON-name-TOP what-HON-PAST-PAR
   "What was your name?"

   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.
<table>
<thead>
<tr>
<th>terms</th>
<th>( \lambda p. \lambda w. \lambda q. \langle s, s &gt; . [ q = p \vee q = \neg p ] )</th>
<th>( \lambda p. \lambda w. \lambda q. \langle s, s &gt; . [ q = p \vee q = \neg p ] ) or ( \lambda p. \lambda w. \lambda w'. \forall w' \in \text{Epi} . (w) . \text{p}(w') = 1 )</th>
<th>( \lambda p. \lambda w. \lambda q. \langle s, s &gt; . [ q = p \vee q = \neg p ] )</th>
</tr>
</thead>
<tbody>
<tr>
<td>category</td>
<td>( S/S/S )</td>
<td>( S/S/S ) or ( S/S )</td>
<td>( S/S/S )</td>
</tr>
<tr>
<td>my proposal</td>
<td>a question marker</td>
<td>a question marker or a polarity focus marker</td>
<td>a tag question marker</td>
</tr>
<tr>
<td>Masuoka - Takubo (1992)</td>
<td>question</td>
<td>question/command</td>
<td>agreement/nt/affirmation</td>
</tr>
<tr>
<td>particle</td>
<td>ka</td>
<td>no</td>
<td>ne</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>yo</td>
<td>na</td>
<td>S\S</td>
<td>S\S</td>
</tr>
<tr>
<td>yo</td>
<td>na</td>
<td>urges a course of action/request/certainty</td>
<td>indicates emotion/asks for agreement</td>
</tr>
<tr>
<td>particle</td>
<td>na</td>
<td>a polarity focus marker</td>
<td>a question marker or an exclamative marker</td>
</tr>
<tr>
<td>yo</td>
<td>na</td>
<td>notification/alert, warning</td>
<td>n, confirmation</td>
</tr>
<tr>
<td>yō</td>
<td>na</td>
<td></td>
<td></td>
</tr>
<tr>
<td>yō</td>
<td>na</td>
<td></td>
<td></td>
</tr>
<tr>
<td>yō</td>
<td>na</td>
<td></td>
<td></td>
</tr>
<tr>
<td>yō</td>
<td>na</td>
<td></td>
<td></td>
</tr>
<tr>
<td>yō</td>
<td>na</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>--------------</td>
<td>-----------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>$p &lt;\text{st}&gt;$</td>
<td>$p &lt;\text{st}&gt;$</td>
<td>$p &lt;\text{st}&gt;$</td>
<td>$p &lt;\text{st}&gt;$</td>
</tr>
<tr>
<td>$\lambda p &lt;\text{st}&gt;. \lambda w &lt;\text{st}&gt;. \lambda q &lt;\text{st}&gt; [q = p \lor q = \neg p]$</td>
<td>$\lambda p &lt;\text{st}&gt;. \lambda w &lt;\text{st}&gt;. \lambda q &lt;\text{st}&gt; [q = p \lor q = \neg p]$</td>
<td>$\lambda p &lt;\text{st}&gt;. \lambda w &lt;\text{st}&gt;. \lambda q &lt;\text{st}&gt; [q = p \lor q = \neg p]$</td>
<td></td>
</tr>
<tr>
<td>$\neg q = \neg p$</td>
<td>$\neg q = \neg p$</td>
<td>$\neg q = \neg p$</td>
<td>$\neg q = \neg p$</td>
</tr>
<tr>
<td>a question marker</td>
<td>a question marker</td>
<td>a question marker</td>
<td>a question marker</td>
</tr>
<tr>
<td>question for recalling shared information</td>
<td>uncertainty/ request</td>
<td>/</td>
<td></td>
</tr>
<tr>
<td>confirm memory</td>
<td>ke</td>
<td>kashir</td>
<td>a</td>
</tr>
</tbody>
</table>
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 \(S\backslash (S/S)\) 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.

\[
\begin{align*}
\text{Hon-o}_{\text{Lex}} & \quad \text{yonderu}_{\text{Lex}} \\
\emptyset_{\text{Lex}} & \quad \text{NP}_{\text{ACC}}: \varepsilon \text{book'} \quad \text{TVP: } \lambda x \lambda y. \text{read'}(x)(y) < \\
\text{NP}_{\text{NOM}}: s \quad \text{VP: } \lambda y. \text{read'}(\varepsilon \text{book'}) (y) < \quad \text{no}_{\text{Lex}} \\
\text{S: } \text{read'}(\varepsilon \text{book'}) (s) & \quad \text{S/S: } \lambda p_{<\text{st}>}. \lambda w. \forall w' \in wRw'[p(w') = 1] < \\
\text{S: } \lambda w_{<s>}. \forall w' \in wRw'[\text{read'}(\varepsilon \text{book'}) (h)(w') = 1]
\end{align*}
\]

(R: epistemic accessibility relation)
No as a Question Particle

b.

\[
\begin{align*}
&\text{Hon-o}_{\text{Lex}} \quad \text{yonderu}_{\text{Lex}} \\
&\emptyset_{\text{Lex}} \quad \text{NP}_{\text{ACC}}: \varepsilon x.\text{book}' \quad \text{TVP}: \lambda x\lambda y.\text{read}'(x)(y) < \\
&\text{NP}_{\text{NOM}}: h \quad \text{VP}: \lambda y.\text{read}'(\varepsilon \text{book}') (y) < \\
&\text{S: read}'(\varepsilon \text{book}') (h) \quad \text{S/S: } \lambda p_{<\text{st}>}.\lambda w_{<\text{st}>}.\lambda q_{<\text{st}>}[q = p \lor q = \neg p] < \\
&\text{S/S: } \lambda w_{<\text{st}>}.\lambda q_{<\text{st}>}[q = \text{read}'(\varepsilon \text{book}') (h) \lor q = \neg \text{read}'(\varepsilon \text{book}') (h)] \\
\end{align*}
\]

(s:speaker, h:hearer)
Yo: Kinsui (1993) Two Usages

• *Kyoji* (teaching/notifying):


``Oh, you have dropped your handkerchief."

• *Chui* (alert):

(22) Omae-wa jukensei-da-yo.

``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) \( \neg \text{Past(Believe(p)(s))} \land \text{Now(Believe(p)(s))} \)
- Hearer now believes what s/he had not believed before.

• Alerting yo:

(24) \( \text{Past(Believe(p)(s))} \land \text{Now(Believe(p)(s))} \)
- 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

gorgeous house-be-EXC
``What a gorgeous house!'' (BCCWJ2009)

impossible-Q-Q
``Will it be impossible?"
**Na as an Epistemic Modal**


(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)

\[ \text{So}_{\text{Lex}} \text{ datta}_{\text{Lex}} \text{ no}_{\text{Lex}} \text{ ka}_{\text{Lex}} \]

\[ \text{NP}:a \ \text{NP}\langle \text{S}:\lambda w,x.\text{be}(x)\rangle \]

\[ \text{S}\langle \text{S/S}: \rangle \]

\[ \text{S}: \text{be}(a) \]

\[ \lambda p_{<st>}.\lambda w_{<s>}.\lambda q_{<st>} [q = p \lor q = \neg p] \]

\[ \lambda p_{<st>}.\lambda w_{<s>}.\lambda q_{<st>} [q = p \lor q = \neg p] \]

\[ \text{S}/\text{S}: \lambda w_{<s>}.\lambda q_{<st>} [q = \text{be}(a) \lor q = \neg \text{be}(a)] \]
Table of Contents

1. Introduction
2. Categories of Questions and Focus in CCG and TLG
3. Proposal: Higher Order for Questions and Polarity Focus
4. Categories of Sentence-final Particles in Japanese

5. Conclusion
Conclusion

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