CCG of Questions and Focus

Sumiyo Nishiguchi
School of Management
Tokyo University of Science
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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:**
  Such novel categories enable combining with the following sentence in a discourse by means of functional application.
Combinatory Categorial Grammar

(1) Rie-wa Chikara-ni atta.
Rie-TOP Chikara-DAT met
“Rie met Chikara”

\[
\begin{align*}
\text{Rie}_{\text{Lex}} & \quad \text{Chikara}_{\text{Lex}} & \quad \text{atta}_{\text{Lex}} \\
\text{NP: } r & \quad \text{NP: } c & \quad \text{NP\(\backslash(NP\backslash S): \lambda x,y.\text{meet}(x)(y)\_<} \\
& \quad \quad \text{NP\(\backslash S: \lambda y.\text{meet}(c)(y)\_<} \\
& \quad \quad \text{S: } \text{meet}(c)(r)
\end{align*}
\]
Combinators

• Functional application >, <

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

• Functional composition >B, <B

\[
\begin{align*}
X/Y \quad Y/Z & \Rightarrow_B X/Z \\
:f & \quad :g & \Rightarrow & \quad :\lambda x.f(g(x)) \\
X\setminus Y \quad Y\setminus Z & \Rightarrow_B X\setminus Z \\
:f & \quad :g & \Rightarrow & \quad :\lambda x.g(f(x))
\end{align*}
\]
What is the category of Japanese sentence-final particles?

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

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

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

\[
\begin{align*}
\text{NP: } r & \quad \text{NP: } c \quad (\text{NP}\backslash S)/\text{NP: } \lambda x,y.\text{meet}(x)(y) < \\
\text{NP}\backslash S: \lambda y.\text{meet}(c)(y) < & \\
\text{S: } \text{meet}(c)(r) & \end{align*}
\]
I analyze...

• *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 $S\backslash(S\backslash S)$.
• 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

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

  theme ate := (S_θ/NP_θ)/NP_θ: *ate'
  L+H*

  rheme ate := (S_ρ/NP_ρ)/NP_ρ: *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:
Meaning of Interrogatives

• The interpretations of an interrogative is a set of possible answers in a given context (Hamblin 1973, Kartunnen 1977)

(7) \{\text{Did you see Alice?}\} =
\{\text{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 st, t \rangle
Focus Alternatives

• Focus induces sets of alternative propositions (Rooth 1985, 1992).

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

(9) \[ | I \text{ went to the BEACH} | \]^{f} = \{I \text{ went shopping, I went hiking, I stayed home,...}\}

(10) \[ | I \text{ went to the BEACH} | \]^{o} = 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 <st, t> more straightforwardly correspond to type $S\backslash S$ rather than $S_Q$ or $S_{FOC}$
Proposal

(11) A polar question: $S\backslash S$: $\{p, \neg p\}$
A focused sentence: $S\backslash S$: $\{p, q, r, \ldots\}$
CCG for Discourse

• Such novel categories adequately handle discourse:

(12) A: Who came?
    B: Mary came.

<table>
<thead>
<tr>
<th>who&lt;sub&gt;Lex&lt;/sub&gt;</th>
<th>came&lt;sub&gt;Lex&lt;/sub&gt;?</th>
<th>Mary&lt;sub&gt;Lex&lt;/sub&gt;</th>
<th>came&lt;sub&gt;Lex&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>(S/S)/(NP$)</td>
<td>NP$</td>
<td>NP</td>
<td>NP$</td>
</tr>
</tbody>
</table>

:\lambda g,w,q[q=g(m) \lor g(a) \lor g(b)] :\lambda w,x.came(x)<

S/S: \lambda w,q[q=came(m) \lor came(a) \lor came(b)]

S: \lambda w.came(m)

S: \lambda w.[came(m)=came(m) \lor came(a) \lor came(b)]

*I benefited from a comment from a reviewer of LACL 2011.*
What about Question to Question Response?*

(13) Presupposition Failure

**Did Mary come?**  **Who is Mary?**

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

**Mary-Jane**

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

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

*I am grateful to the question raised in FUN after my talk.*

6/2/2011 Sumiyo Nishiguchi, JSAI2011
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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*.
(14) 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?"
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
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>
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<tbody>
<tr>
<td>ka</td>
<td>question</td>
<td>a question marker/an exclamative marker</td>
<td>S(\S\S))</td>
<td>(\lambda p_{\text{st}}.\lambda w_{\text{st}}.\lambda q_{\text{st}}[q = p \lor q = \neg p])</td>
<td></td>
</tr>
<tr>
<td>no</td>
<td>question/command</td>
<td>question marker or a polarity focus marker (Höhle 1992, Romero &amp; Han 2004).</td>
<td>S(\S\S) or S\S</td>
<td>(\lambda p_{\text{st}}.\lambda w_{\text{st}}.\lambda q_{\text{st}}[q = p \lor q = \neg p]) or (\lambda p_{\text{st}}.\lambda w.\forall w' \in \text{Epi}_x(w)[p(w') = 1])</td>
<td></td>
</tr>
<tr>
<td>ne</td>
<td>agreement/affirmation</td>
<td>admiration/agreement/request softener</td>
<td>a tag question marker</td>
<td>S(\S\S)</td>
<td>(\lambda p_{\text{st}}.\lambda w_{\text{st}}.\lambda q_{\text{st}}[q = p \lor q = \neg p])</td>
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<tr>
<td>yo</td>
<td>notification/alert, warning</td>
<td>urges a course of action/request/certainty</td>
<td>a polarity focus marker</td>
<td>$S\backslash S \quad \lambda p_{&lt;st&gt;}.\lambda w_{&lt;ss&gt;}. \forall w' \in Epi_x(w) [p(w') = 1]$</td>
<td></td>
</tr>
<tr>
<td>na</td>
<td>confirmation, agreement</td>
<td>indicates emotion/asks for agreement</td>
<td>a question marker or an exclamative marker</td>
<td>$S\backslash (S\backslash S) \quad \lambda p_{&lt;st&gt;}.\lambda w_{&lt;ss&gt;}.\lambda q_{&lt;st&gt;} [q = p \lor q = \neg p]$</td>
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</tr>
<tr>
<td><strong>ke</strong></td>
<td>confirm memory</td>
<td>question for recalling shared information</td>
<td>a question marker</td>
<td>$S{S} \lambda p_{st} . \lambda w_{ss} . \lambda q_{st} [q = p \lor q = \neg p]$</td>
<td></td>
</tr>
<tr>
<td><strong>kashira</strong></td>
<td>uncertainty / question/ request</td>
<td>a question marker</td>
<td>$S{S} \lambda p_{st} . \lambda w_{ss} . \lambda q_{st} [q = p \lor q = \neg p]$</td>
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<td></td>
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</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).

(17) 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 $<\text{st}, <\text{st}, \text{t}>$

  more straightforwardly correspond to type $S\backslash(S\backslash S)$

  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)
(18) 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

(19)a.

$$\text{Hon-o}_{\text{Lex}} \quad \text{yonderu}_{\text{Lex}}$$

$$\emptyset_{\text{Lex}} \quad \text{NP}_{\text{ACC}}: \varepsilon\text{x.book'} \quad \text{TVP}: \lambda x \lambda y. \text{read'}(x)(y) <$$

$$\text{NP}_{\text{NOM}}: s \quad \text{VP}: \lambda y. \text{read'}(\varepsilon\text{x.book'}) (y) < \quad \text{no}_{\text{Lex}}$$

$$\text{S: read'}(\varepsilon\text{x.book'})(s) \quad \text{S}: \lambda p_{<\text{st}}. \lambda w. \forall w' \in \text{wRw'}[p(w') = 1] <$$

$$\text{S: } \lambda w_{<s}. \forall w' \in \text{wRw'}[\text{read'}(\varepsilon\text{x.book'})(h)(w') = 1]$$

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

b. 

\[
\begin{align*}
\text{Hon-o}_{\text{Lex}} & \quad \text{yonderu}_{\text{Lex}} \\
\emptyset_{\text{Lex}} & \quad \text{NP}_{\text{ACC}}: \ v_{\text{ex.book'}} \quad \text{TVP}: \ \lambda x \lambda y. \text{read'}(x)(y) < \\
\text{NP}_{\text{NOM}}: h & \quad \text{VP}: \ \lambda y. \text{read'}(\varepsilon \text{ex.book'})(y) < \\
\text{S}: \ \text{read'}(\varepsilon \text{ex.book'})(h) & \quad \text{S}(\text{S}): \ \lambda p_{\langle \text{st} \rangle}. \lambda w_{\langle \text{s} \rangle}. \lambda q_{\langle \text{st} \rangle}[q = p \lor q = \neg p] < \\
\text{S}: \ \lambda w_{\langle \text{s} \rangle}. \lambda q_{\langle \text{st} \rangle}[q = \text{read'}(\varepsilon \text{ex.book'})(h) \lor q = \neg \text{read'}(\varepsilon \text{ex.book'})(h)] < \\
\text{(s:speaker, h:hearer)}
\end{align*}
\]
Yo: Kinsui (1993) Two Usages

• *Kyoji* (teaching/notifying):

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

• *Chui* (alert):

(21) 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:

\[(22) \quad \neg \text{Past}(\text{Believe}(p)(s)) \land \text{Now}(\text{Believe}(p)(s))\]

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

• Alerting yo:

\[(23) \quad \text{Past}(\text{Believe}(p)(s)) \land \text{Now}(\text{Believe}(p)(s))\]

- 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

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

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


(26) 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.

(27) So-dat-ta-no-ka.
so-be-PAST-PAR-PAR
``Was it so?''

(28) Kyo-wa i tenki-da-yo-na.
today-TOP good weather-be-PAR-PAR
``Isn't it good weather today?"
Functional Composition

(29)

\[
\begin{align*}
\text{So}_{\text{Lex}} & \quad \text{datta}_{\text{Lex}} & \quad \text{no}_{\text{Lex}} & \quad \text{ka}_{\text{Lex}} \\
\text{NP}:a & \quad \text{NP}\text{\S}:\lambda w,x.\text{be}(x) & \quad \text{S}\text{\S}:(S\text{\S}): & \quad \text{S}\text{\S}:(S\text{\S}): \\
\text{S}: \text{be}(a) & \quad \lambda p_{\text{st}}.\lambda w_{\text{s}}.\lambda q_{\text{st}}[q = p \lor q = \neg p] & \quad \lambda p_{\text{st}}.\lambda w_{\text{s}}.\lambda q_{\text{st}}[q = p \lor q = \neg p] \\
\text{S}\text{\S}: \lambda w_{\text{s}}.\lambda q_{\text{st}}[q = \text{be}(a) \lor q = \neg \text{be}(a)]
\end{align*}
\]
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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.