CCG for Discourse

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Abstract

Question and answer congruence has been considered to be a discourse unit (Groenendijk and Stokhof 1984, Ginzburg and Sag 2001). I propose a new framework for question-answer pairs and focused sentences in Combinatory Categorial Grammar (CCG) (Steedman 2000). In CCG, questions and focused sentences have been assigned the categories of S (Jäger 2005, Barker and chieh Shan 2006), while questions are sets of possible answers semantically (Hamblin 1973). Pragmatically, focus induces a set of alternatives (Rooth 1992). I claim that interrogatives and focused sentences should be functions from a sentence to another sentence in view of their semantics. Such novel categories enable combining with the following sentence in a discourse by functional application. Thereby, Japanese sentence-final particles such as a question marker *ka* are category S\(S/S), and *yo* and *no* are polarity focus operators (Höhle 1992).

1 Modality in CCG and TLG

In CCG, questions, focused sentences and exclamatives have been considered to be of the category S, or a sentence. Steedman (2000) specifies features for focused sentences and uses prosodically annotated categories. Barker and chieh Shan (2006), in multi-modal TLG, introduces a modality $\circ ?$ to term questions. The category of a question sentence is $_?$S and the lexical category of *what* is (NP\$_?$S)/(NP\S) which combines with a predicate and returns a function from NP to a question sentence. Jäger (2005) terms questions as the category *q*, and *wh*-phrases *q*/(*np*↑*s*), a function from a predicate to a question. In Hockenmaier and Steedman (2007), S carries a feature— declaratives (S[dcl]), *wh*-questions (S[wq]), *yes-no* questions (S[q]), or fragments (S[frg]). Even though the proposed modalized sentence categories are useful for controlling combinatorics, such modality is not really necessary if syntax-semantics correspondence is more strictly pursued.

2 Proposal: Higher Order for Questions and Polarity Focus

Syntactic categories should reflect the semantic content of questions and focused sentences.

2.1 Semantics of Questions and Focus

Semantically speaking, the denotation of a question or a focused sentence is assumed to be a set of propositions. For example, the interpretation of *Did you see Alice* is a set of possible answers in a given context (Hamblin 1973, Kartunnen 1977):

(1) $[\![Did\_you\_see\_Alice?]\!]$ = {you saw Alice, you did not see Alice}

Since a proposition is a set of possible worlds which is of type <s, t>, the set of possible answers is a set of sets of possible worlds, <st, t> . Focus induces sets of alternative propositions (Rooth 1992). In (2a), the alternative answers along with the real answer form a set of contextually possible answers called focus semantics value ("f") without truth-conditional contribution.

(2) a. A: Where did you go on weekend?
B: I went to the BEACH.
b. $[\![I\_went\_to\_the\_BEACH]\!]^f$
= {I went shopping, I went hiking, I stayed home,...}

2.2 New Lexical Category for Questions and Focus

The semantic type of questions and focused sentences <st, t> more straightforwardly correspond to type S/S rather than S_Q or S_{foc} even though there is no syntactic composition of two sentences. Therefore, I propose the following lexical entries.

(3) a. A polar question: S/S: {p, ¬p}

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

Such novel categories can handle discourse:

$$\dfrac{\dfrac{\dfrac{who}{(S/S)/(NP\backslash S) : \lambda f_{<et>}, p_{<t>}.\pi(p)}\text{Lex} \quad \dfrac{came}{NP\backslash S : \lambda x.came'(x)}\text{Lex}}{S/S : \lambda p.\pi(p)}> \quad \dfrac{\dfrac{Mary}{NP : m}\text{Lex} \quad \dfrac{did}{NP\backslash S : \lambda x.f(x)}\text{Lex}}{S : f(m)}<}{S : \pi(f(m))}>$$

The syntactic category of the question *who came* is S/S which combines with the answer by means of inter-sentential functional application.

(4) Functional Application

A/B: f, B: a ⇒ A: f(a) (>)

A: a, A\B: f ⇒ B: f(a) (<)

2.3 Fragmental Answers as Propositions

If we consider questions as sets of propositions, how would the questions combine with fragmental answers in the forms of NPs, VPs, or PPs that are not full Ss? From pragmatic viewpoint, Stainton (2004) considers assertions of non-propositional fragments as type <t>.

(5) A: What did you eat?

B: Apples.

Although "Apples." is a noun phrase whose semantic type is <et, t>, its pragmatic contribution is the same as "I ate apples" of type <t>, which is the form before ellipsis. In the present analysis, inter-sentential functional application requires the response to be category S. As the pragmatic contribution of fragmental answers are of S and not NP, PP or VP, semantic type-raising of fragmental answers to the category S makes functional application possible between questions and fragmental answers.

2.4 Question-question Congruence

Sometimes questions are replied with another question in cases of presupposition failure. In (6), the speaker's presupposition that the proper name *Alice* has reference is not shared by the hearer. Functional application cannot be applied because the second question of type S/S cannot be an argument of the first question of type S/S. Instead of functional application, functional composition is necessary (Curry and Feys 1958, Steedman 2000).

(6) a. Forward Composition (>B)

A/B B/C $\rightarrow_B$ A/C

b. Backward Composition (<B)

A\B B\C $\rightarrow_B$ A\C

(7) A: Did you see Alice?

B: Who is Alice?

$$\dfrac{\dfrac{\dfrac{Did}{(S/S)/S : \lambda p_{<t>}, p.\pi_{<t,t>}(p)}\text{Lex} \quad \dfrac{\dfrac{you}{NP : h}\text{Lex} \quad \dfrac{\dfrac{see}{(NP\backslash S)/NP : \lambda x, y.see'(x)(y)}\text{Lex} \quad \dfrac{Alice}{NP : a}\text{Lex}}{NP\backslash S : \lambda y.see'(a)(y)}>}{S : see'(a)(h)}<}{S/S : \lambda p.\pi(see'(a)(h))}> \quad \dfrac{\dfrac{Who}{(S/S)/(NP\backslash S) : \lambda f_{<et>}, p.\rho(p)}\text{Lex} \quad \dfrac{\dfrac{is}{(NP\backslash S)/NP : \lambda x, y.be'(x)(y)}\text{Lex} \quad \dfrac{Alice}{NP : a}\text{Lex}}{NP\backslash S : \lambda x.be'(a)(x)}>}{S/S : \lambda p.\rho(p)}>}{S/S : \lambda f.\lambda p.\pi(see'(a)(h))((\lambda p.\rho(p))(f))}>B$$

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