Clarification Ellipses, HPSG and dependent record types

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Overview

- Sketch of a phenomenon – clarification ellipsis
- An HPSG approach
- Translating the HPSG approach to a record-based approach
- The big picture – future research directions
Clarification Ellipsis

A: Did Bo finagle a raise? B: (i) Bo?/ (ii) finagle?

**Clausal (focus) reading**: Are you asking if BO (of all people) finagled a raise/Bo FINAGLED a raise (of all actions)

**Constituent (identification) reading**: Who is Bo?/What does it mean to finagle?

1. **Clausal (focus) reading**: (yes/no) question used to confirm the content of a particular subutterance in the context of the whole utterance.
2. **Constituent (identification) reading**: (wh) question used to find out intended content of a subutterance.
Clarification Ellipsis: dialogue systems

- Sys: Would you like to make that trip via Malvern?
  User: Malvern?

- Appropriate responses might be:

  System: Malvern – M-A-L-V-E-R-N
  \textit{constituent/identification}

  System: Going via Malvern is the quickest route
  \textit{clausal/focus}

  System: Yes, Malvern
  \textit{either reading}

The system should definitely NOT say

So, you would like to make that trip via Malvern instead of Malvern?
Identification is part of the general interpretation process

A: Did Bo kowtow?

- A’s question: whether the property she has referred to with her utterance of *kowtow* holds of the person she has referred to with the name *Bo*.

- B’s task: find values for these references; finding values is, with caveats, a necessary condition for B to ground A’s utterance, thereby signalling that its content has been integrated in B’s IS.

- Constraint on the representation of utterance types: such a representation must involve a function from or λ-abstract over a set of certain parameters (the *contextual parameters*) to contents. (See work on context dependence from Montague et seq.)
What do you do if identification fails?

- What if B cannot or is at least uncertain as to how he should instantiate in his IS a contextual parameter \( i \) ?

  1. Perform a partial update of the existing context with the successfully processed components of the utterance, possibly existentially quantifying over unknown elements.

  2. Pose a clarification question that involves reference to the sub-utterance \( u_i \) from which \( i \) emanates.

- Interpretations of previous utterances can be coerced to clarification questions.
Coercion Operations: first pass

- CE gives us some indication concerning both the input and required output of these operations.

- **parameter identification**: output a question paraphrasable as *what is the intended reference of sub-utterance uᵢ?*; partially updated context: repetition of the segmental phonology of uᵢ using rising intonation enables that question to be expressed.

- **parameter focussing**: partially updated context in which the issue under discussion is a question that arises by instantiating all contextual parameters except for i and abstracting over i; In such a context, one can confirm that i gets the value B suspects it has by uttering with rising intonation any apparently co-referential phrase whose syntactic category is identical to u₁’s.
Requisite Modification to HPSG

Did Bo leave?

```
[ root-cl
  PHON did bo leave
  CAT V [+fin]
  C-INDICES {1,2,3, i,j}
    [ ask-rel
      ASKER i
      ASKED j
    ]
  CONT
    MSG-ARG
      question
      PARAMS {}
      prop|SOA
        leave-rel
          AGT 1
          TIME 2
    ]
  CTXT|BCKGRD
    {utt-time(3), precede(2,3), named(bo)(1)}
  ]
```
Strategic Modelling Assumptions

- Context consists of distinct but coupled information states: each information state contains a (participant relative) record of public interactions.

\[
\begin{bmatrix}
\text{FACTS} & \text{set of facts} \\
\text{LATEST-MOVE} & \text{(illocutionary) fact} \\
\text{QUD} & \text{p.o. set of questions}
\end{bmatrix}
\]

- QUĐ represents the issues currently under discussion; locus of control for interactive coherence.

- FACTS represents conversationally presupposed information.

- LATEST-MOVE represents the (content of the) most recent conversational move.
Coercion operations: parameter identification

(1)

\[
\begin{align*}
\text{root-cl} & \\
\text{CTXT-INDICES} & \{ \ldots \# \ldots \} \\
\text{CONSTITS} & \{ \ldots \llbracket \text{CONT} \# \rrbracket \ldots \} \\
\ldots & \\
\Rightarrow & \\
\text{CONTMSG-ARG} & \llbracket \text{question} \rrbracket \\
\text{SAL-UTT} & 2 \\
\text{PARAMS} & \llbracket \llbracket \text{INDEX} \# \rrbracket \rrbracket \\
\text{PROP} & 3 \\
\text{SOA} & \\
\text{CONT} & 3 \\
\text{SIGN} & 2 \\
\text{content-rel} & \\
\text{cont} & 4 \\
\end{align*}
\]
Parameter identification update – example

a. Who do you mean BO?
b. WHO? (= who is Bo)
c. Bo? (= who is Bo)

(2)

CONT| MSG-ARG

PROP [question]

PHON bo
CAT NP
CONT|INDEX

CTXT|BCKGRD { named(Bo) }

question

PARAMS { [INDEX] }

PROP [content-rel]

SOA [SIGN]

CONT
Coercion operations: parameter focussing

(3)

\[
\begin{align*}
\text{root-cl} & \quad \{ \ldots \} \\
\text{C-INDICES} & \quad \{ \ldots \} \\
\text{CONSTITS} & \quad \{ \ldots \} \\
\text{CONT} & \quad \{ \ldots \} \\
\Rightarrow & \\
\text{CONT|MSG-ARG} & \quad \{ \text{question} \} \\
\text{SAL-UTT} & \quad \{ \text{question} \} \\
\text{MAX-QUD} & \quad \{ \text{question} \} \\
\end{align*}
\]

- Previous utterance
- Repeated utterance in current utterance
- Game-board update
Parameter focussing update – example

a. Did WHO leave?
b. WHO?
c. BO? (= Are you asking if BO left?)
Representing HPSG signs in terms of (something like) dependent record types

Families of dependent record types – functions from records to record types

\( \lambda r : T_1(T_2) \) – a function from records of type \( T_1 \) to the type \( T_2 \) (dependent on \( r \))

“Utterance skeleton”, “meaning”, “HPSG sign”
Representing utterances

\[ u_1 : 0 \text{ Did }_1 \text{ Bo }_2 \text{ leave }_3 \]

\[ u_{1,0-1} \text{ is to represent the utterance of } \text{did} \text{ in } u_1 \]

**Abbreviation**

\[
\left[ f_{u_{i,n-m}} : T \right]
\]

is to be an abbreviation for

\[
\left[
\begin{array}{c}
  f_{u_{i,n-m}} : T \\
  pf-f_{u_{i,n-m}} : f(u_{i,n-m}, f_{u_{i,n-m}})
\end{array}
\right]
\]

e.g., \[
\left[ \text{utt-time}_{u_{1,0-3}} : Time \right] \text{ (Time the type of time intervals)}
\]

abbreviates

\[
\left[
\begin{array}{c}
  \text{utt-time}_{u_{1,0-3}} : Time \\
  pf-\text{utt-time}_{u_{1,0-3}} : \text{utt-time}(u_{1,0-3}, \text{utt-time}_{u_{1,0-3}})
\end{array}
\right]
\]
$u_1 : 0$ Did 1 Bo 2 leave 3

$\lambda r : [\ldots ]( \begin{bmatrix} \text{msg}_{u_1,0-3} : ?\text{leave} & \text{ev-time}_{u_1,0-3} \\ \text{cont}_{u_1,0-3} : \text{ask} & \text{sp}_{u_1,0-3} & \text{hearer}_{u_1,0-3} & \text{msg}_{u_1,0-3} \end{bmatrix} )$

More properly:

$\lambda r : [\ldots ]( \begin{bmatrix} \text{msg}_{u_1,0-3} : ?\text{leave} & \text{ev-time}_{u_1,0-3} \\ \text{cont}_{u_1,0-3} : \text{ask} & \text{sp}_{u_1,0-3} & \text{hearer}_{u_1,0-3} & \text{msg}_{u_1,0-3} \end{bmatrix} )$

but I will suppress all the extra $r$’s as there is no risk of confusion.
filling in the dots ...

\[
\begin{align*}
\lambda r : & \begin{cases} 
\text{phon}_{u_1,0-1} & : /dId/ \\
\text{phon}_{u_1,1-2} & : /bu/ \\
\text{phon}_{u_1,2-3} & : /liv/ \\
\text{phon}_{u_1,0-3} & : /\text{dI}d\text{bulív}/ \\
\text{utt-time}_{u_1,0-3} & : \text{\textit{Time}} \\
\text{ev-time}_{u_1,0-3} & : \text{\textit{Time}} \\
\text{tense}_{u_1,0-3} & : \text{ev-time}_{u_1,0-3} < \text{utt-time}_{u_1,0-3} \\
\text{ref}_{u_1,1-2} & : \text{\textit{Ind}} \\
\text{res}_{u_1,1-2} & : \text{\textit{named}}(\text{ref}_{u_1,1-2}, "\text{Bo}") \\
\text{sp}_{u_1,0-3} & : \text{\textit{Ind}} \\
\text{hearer}_{u_1,0-3} & : \text{\textit{Ind}} \\
\text{cat}_{u_1,0-3} & : [\text{V, +fin}] \\
\end{cases} \\
\left( \begin{array}{c}
\text{msg}_{u_1,0-3} \\
\text{cont}_{u_1,0-3}
\end{array} \right) \\
\left( \begin{array}{c}
?\text{leave}(\text{ref}_{u_1,1-2}, \text{ev-time}_{u_1,0-3}) \\
\text{ask}(\text{sp}_{u_1,0-3}, \text{hearer}_{u_1,0-3}, \text{msg}_{u_1,0-3})
\end{array} \right)
\end{align*}
\]
Suppose your context is defective - you don’t have a referent for Bo.

\[ \lambda r : \]

\[
\begin{align*}
\text{phon}_{u_1,0-1} & : /dId/ \\
\text{phon}_{u_1,1-2} & : /bu/ \\
\text{phon}_{u_1,2-3} & : /liv/ \\
\text{phon}_{u_1,0-3} & : /dIdbulív/ \\
\text{utt-time}_{u_1,0-3} & : Time \\
\text{ev-time}_{u_1,0-3} & : Time \\
\text{tense}_{u_1,0-3} & : \text{ev-time}_{u_1,0-3} < \text{utt-time}_{u_1,0-3} \\
\text{ref}_{u_1,1-2} & : Ind \\
\text{res}_{u_1,1-2} & : \text{named(}\text{ref}_{u_1,1-2}, \text{“Bo”}) \\
\text{sp}_{u_1,0-3} & : Ind \\
\text{hearer}_{u_1,0-3} & : Ind \\
\text{cat}_{u_1,0-3} & : [V, +\text{fin}] \\
\end{align*}
\]

\[
\begin{bmatrix}
\text{msg}_{u_1,0-3} & : \text{?leave} (\text{ref}_{u_1,1-2}, \text{ev-time}_{u_1,0-3}) \\
\text{cont}_{u_1,0-3} & : \text{ask}(\text{sp}_{u_1,0-3}, \text{hearer}_{u_1,0-3}, \text{msg}_{u_1,0-3})
\end{bmatrix}
\]
Coercion 1 – Lowering

Existential quantification of deficient parameters

She’s asking whether somebody named Bo left

$$\lambda r : \left[ \begin{array}{l}
\text{phon}_{u_1,0-1} : /dId/ \\
\text{phon}_{u_1,1-2} : /bu/ \\
\text{phon}_{u_1,2-3} : /liv/ \\
\text{phon}_{u_1,0-3} : /dIdbulív/ \\
\text{utt-time}_{u_1,0-3} : Time \\
\text{ev-time}_{u_1,0-3} : Time \\
\text{tense}_{u_1,0-3} : \text{ev-time}_{u_1,0-3} < \text{utt-time}_{u_1,0-3} \\
\text{sp}_{u_1,0-3} : \text{Ind} \\
\text{hearer}_{u_1,0-3} : \text{Ind} \\
\text{cat}_{u_1,0-3} : [V, +\text{fin}] \\
\end{array} \right]$$

$$\left[ \begin{array}{l}
\text{ref}_{u_1,1-2} : \text{Ind} \\
\text{res}_{u_1,1-2} : \text{named(}\text{ref}_{u_1,1-2}, \text{“Bo”}\text{)} \\
\text{msg}_{u_1,0-3} : ?\text{leave(}\text{ref}_{u_1,1-2}, \text{ev-time}_{u_1,0-3}\text{)} \\
\text{cont}_{u_1,0-3} : \text{ask(}\text{sp}_{u_1,0-3}, \text{hearer}_{u_1,0-3}, \text{msg}_{u_1,0-3}\text{)} \\
\end{array} \right]$$
Coercion 2 - parameter identification

Ask a question for the value of the parameter

\[ u_2 : 0 \text{ Bo?}_1 \]

Who is referred to by your utterance of “Bo”?

\[
\lambda r : \begin{bmatrix}
\text{phon}_{u_1,0-1} : /d\text{Id}/ \\
\text{phon}_{u_1,1-2} : /bu/ \\
\text{phon}_{u_1,2-3} : /liv/ \\
\text{phon}_{u_1,0-3} : /d\text{Idbulív}/ \\
\text{utt-time}_{u_1,0-3} : Time \\
\text{ev-time}_{u_1,0-3} : Time \\
\text{tense}_{u_1,0-3} : \text{ev-time}_{u_1,0-3} < \text{utt-time}_{u_1,0-3} \\
\text{sp}_{u_1,0-3} : \text{Ind} \\
\text{hearer}_{u_1,0-3} : \text{Ind} \\
\text{cat}_{u_1,0-3} : [V, +\text{fin}] \\
\text{phon}_{u_2,0-1} : /bu \ L-H/ \\
\text{utt-time}_{u_2,0-1} : Time \\
\text{sp}_{u_2,0-1} : \text{Ind} \\
\text{hearer}_{u_2,0-1} : \text{Ind}
\end{bmatrix}
\]

\[
\begin{bmatrix}
\text{msg}_{u_2,0-1} : ? \lambda r' : \begin{cases}
\text{ref}_{u_1,1-2} : \text{Ind} \\
\text{res}_{u_1,1-2} : \text{named}(\text{ref}_{u_1,1-2}, \text{Bo}) \\
(\text{ref}(u_{1,1-2}, \text{ref}_{u_1,1-2}))
\end{cases}
\end{bmatrix}
\]

N.B. This last case splits up the abbreviatory convention concerning ref and pf-ref. The type of pf-ref has been used as the body of the question instead.
Coercion 3 – parameter focussing

Are you asking whether Bo left? (The relevant issue is *who left?*)

\[
\lambda r : \begin{bmatrix}
\text{phon}_{u_1,0-1} & : /dI\acute{d}/ \\
\text{phon}_{u_1,1-2} & : /bu/ \\
\text{phon}_{u_1,2-3} & : /liv/ \\
\text{phon}_{u_1,0-3} & : /dIdbuliv/ \\
\text{utt-time}_{u_1,0-3} & : \text{Time} \\
\text{ev-time}_{u_1,0-3} & : \text{Time} \\
\text{tense}_{u_1,0-3} & : \text{ev-time}_{u_1,0-3} < \text{utt-time}_{u_1,0-3} \\
\text{ref}_{u_1,1-2} & : \text{Ind} \\
\text{res}_{u_1,1-2} & : \text{named(ref}_{u_1,1-2}, \text{“Bo”)} \\
\text{sp}_{u_1,0-3} & : \text{Ind} \\
\text{hearer}_{u_1,0-3} & : \text{Ind} \\
\text{cat}_{u_1,0-3} & : [V, +\text{fin}] \\
\text{phon}_{u_2,0-1} & : /bu L-H/ \\
\text{utt-time}_{u_2,0-1} & : \text{Time} \\
\text{sp}_{u_2,0-1} & : \text{Ind} \\
\text{hearer}_{u_2,0-1} & : \text{Ind} \\
\end{bmatrix}
\]

\[
\begin{align*}
\text{max-QUD}_{u_2,0-1} & : ? \lambda x : \text{Ind} \ (\text{ask} (\text{sp}_{u_1,0-3}, \text{hearer}_{u_1,0-3}, ?\text{leave} (x, \text{ev-time}_{u_1,0-3}))) \\
\text{cont}_{u_2,0-1} & : ? \text{ask} (\text{sp}_{u_1,0-3}, \text{hearer}_{u_1,0-3}, ?\text{leave} (\text{ref}_{u_1,1-2}, \text{ev-time}_{u_1,0-3}))
\end{align*}
\]
Future work

- Translate fragment in Ginzburg and Sag’s book to record based grammar
- Look at general relationship HPSG-RBG
- Incorporate recent work by Thierry Coquand et al. – equalities in record types
- Relate to GF – can/should GF be extended to include this kind of grammar? Are there other ways of achieving similar effects
- RBG and GoDiS/ibis – is this the way to go to incorporate “real” semantics into our dialogue management? Should RBG provide a field in an information state or should the whole information state be a dependent record type?
- Relationship RBG and DRT/dynamic semantics
- Relationship RBG and “flat” (“bits and pieces”) semantics (minimal recursion semantics, semantic charts)
- Computational issues: logic vs functional programming or both (prolog, haskell, oz)
The hope

Get HPSG, dynamic and flat semantics and dialogue management into a single powerful computationally tractable formalism