

# Clarification Ellipses, HPSG and dependent record types

Robin Cooper

Göteborg University

and

Jonathan Ginzburg

King's College, London

# 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

*constituent/identification*

System: Going via Malvern is the quickest route

*clausal/focus*

System: Yes, Malvern

*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  $\lambda$ -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?

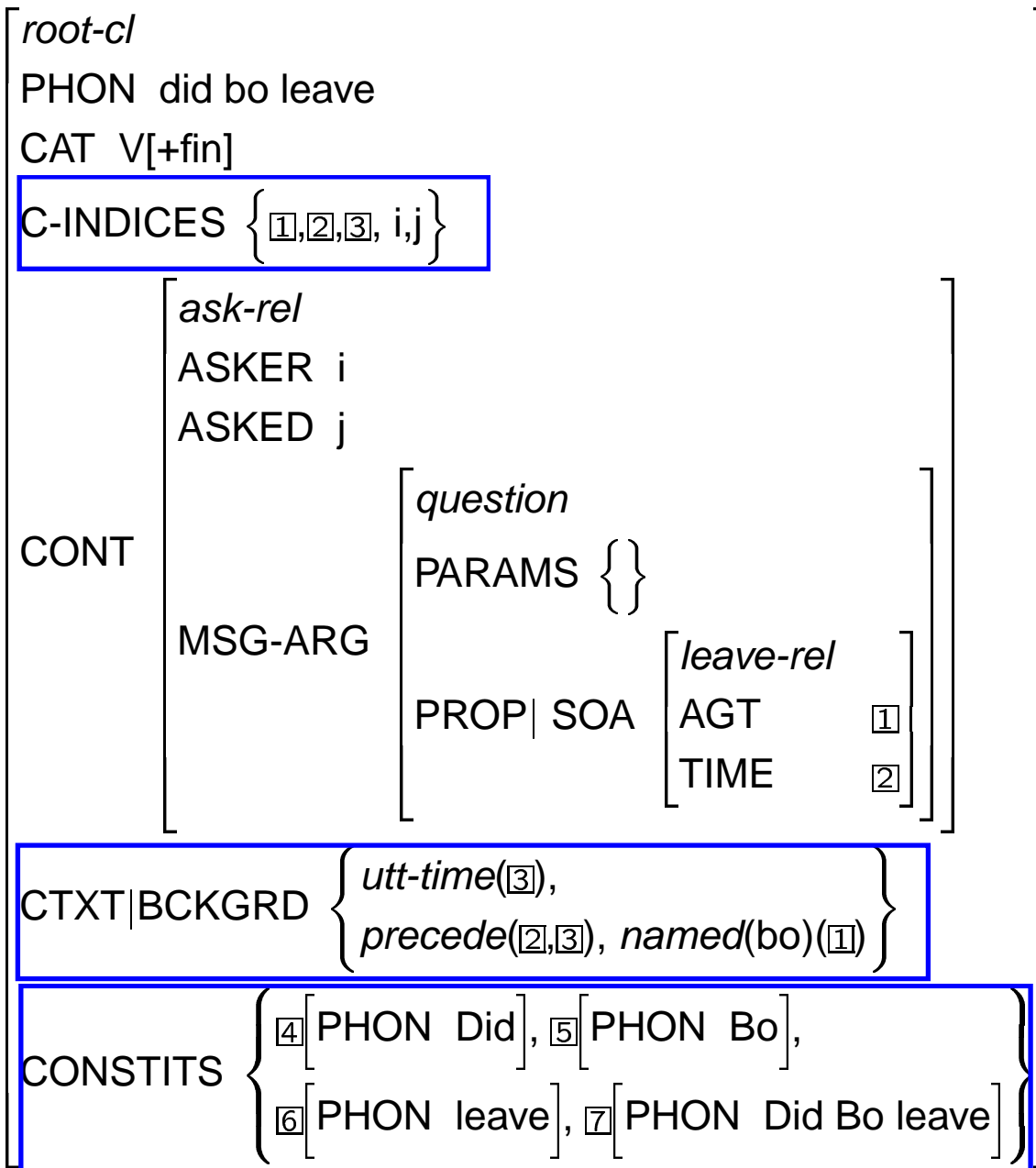
- What if B cannot or is at least uncertain as to how he should instantiate in his IS a contextual parameter  $i$ ?
  1. Perform a partial update of the existing context with the successfully processed components of the utterance, possibly existentially quantifying over unknown elements.
  2. Pose a 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  $u_i$ ?*; partially updated context: repetition of the segmental phonology of  $u_i$  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  $u_1$ 's.

# Requisite Modification to HPSG

Did Bo leave?



## Strategic Modelling Assumptions

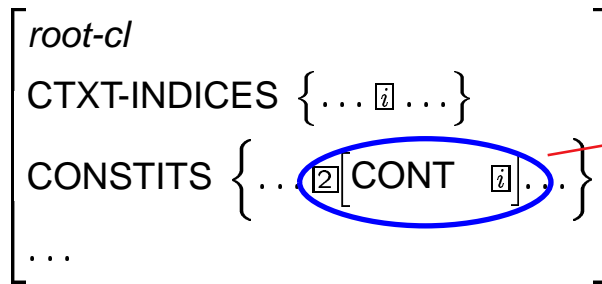
- Context consists of distinct but coupled information states: each information state contains a (participant relative) record of public interactions.

FACTS	<i>set of facts</i>
LATEST-MOVE	<i>(illocutionary) fact</i>
QUD	<i>p.o. set of questions</i>

- QUD 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

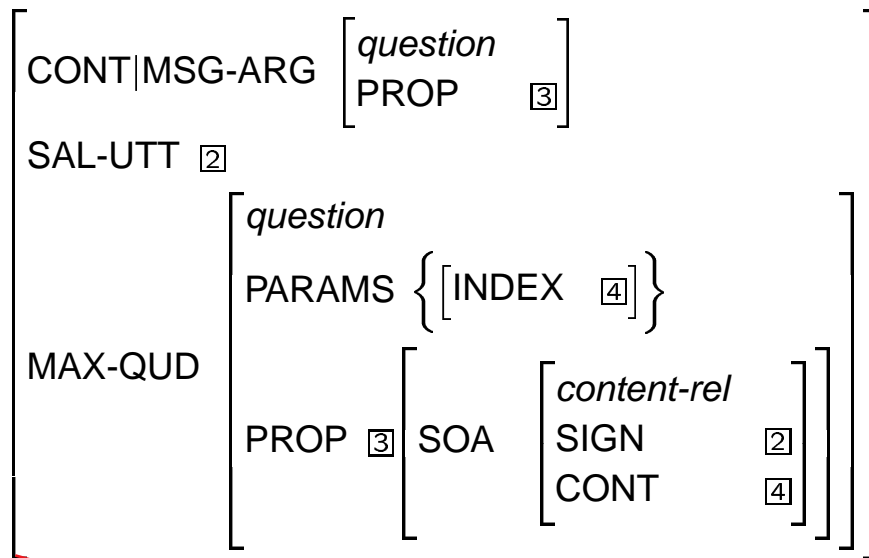
(1)



Previous utterance

Repeated utterance in current utterance

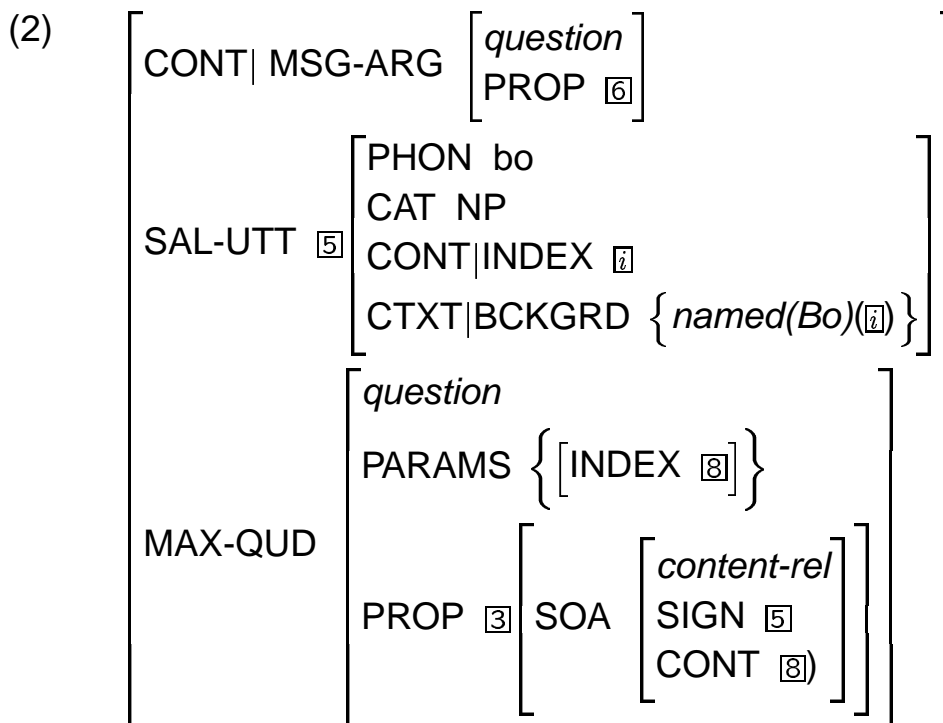
⇒



Game-board update

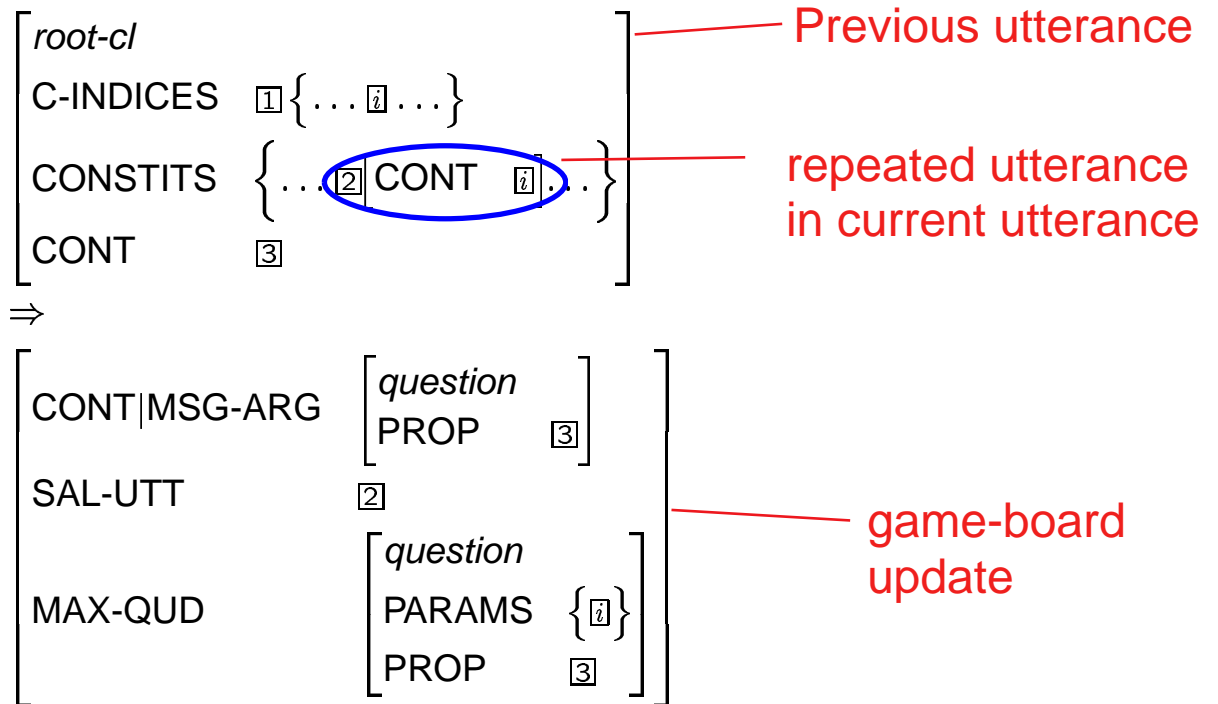
## Parameter identification update – example

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



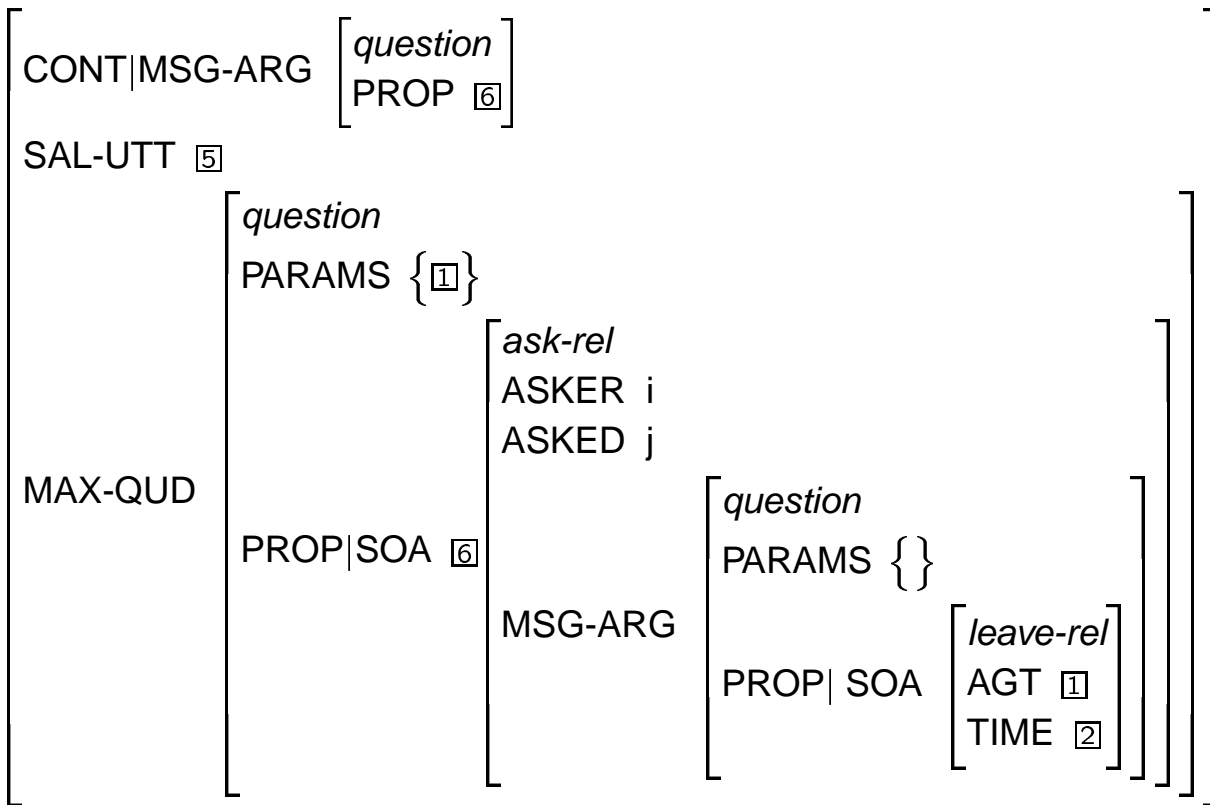
## Coercion operations: parameter focussing

(3)



## 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

$u_1 : 0 \text{ Did } 1 \text{ Bo } 2 \text{ leave } 3$

$u_{1,0-1}$  is to represent the utterance of *did* in  $u_1$

*Abbreviation*

$[ f_{u_{i,n-m}} : T ]$

is to be an abbreviation for

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

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

abbreviates

$[ \begin{array}{l} \text{utt-time}_{u_{1,0-3}} : Time \\ \text{pf-utt-time}_{u_{1,0-3}} : \text{utt-time}(u_{1,0-3}, \text{utt-time}_{u_{1,0-3}}) \end{array} ]$

$u_1 : 0$  Did  $_1$  Bo  $_2$  leave  $_3$

$\lambda r : [ \dots ] \left( \begin{array}{l} \text{msg}_{u_1,0-3} : ?\text{leave}(\text{ref}_{u_1,1-2}, \text{ev-time}_{u_1,0-3}) \\ \text{cont}_{u_1,0-3} : \text{ask}(\text{sp}_{u_1,0-3}, \text{hearer}_{u_1,0-3}, \text{msg}_{u_1,0-3}) \end{array} \right)$

More properly:

$\lambda r : [ \dots ] \left( \begin{array}{l} \text{msg}_{u_1,0-3} : ?\text{leave}(r.\text{ref}_{u_1,1-2}, r.\text{ev-time}_{u_1,0-3}) \\ \text{cont}_{u_1,0-3} : \text{ask}(r.\text{sp}_{u_1,0-3}, r.\text{hearer}_{u_1,0-3}, \text{msg}_{u_1,0-3}) \end{array} \right)$

but I will suppress all the extra  $r$ 's as there is no risk of confusion.

filling in the dots ...

$$\lambda r : \left[ \begin{array}{ll} \text{phon}_{u_{1,0-1}} & : \text{/dId/} \\ \text{phon}_{u_{1,1-2}} & : \text{/bu/} \\ \text{phon}_{u_{1,2-3}} & : \text{/liv/} \\ \text{phon}_{u_{1,0-3}} & : \text{/dIdbulív/} \\ \text{utt-time}_{u_{1,0-3}} & : \textit{Time} \\ \text{ev-time}_{u_{1,0-3}} & : \textit{Time} \\ \text{tense}_{u_{1,0-3}} & : \text{ev-time}_{u_{1,0-3}} < \text{utt-time}_{u_{1,0-3}} \\ \text{ref}_{u_{1,1-2}} & : \textit{Ind} \\ \text{res}_{u_{1,1-2}} & : \text{named}(\text{ref}_{u_{1,1-2}}, \text{“Bo”}) \\ \text{sp}_{u_{1,0-3}} & : \textit{Ind} \\ \text{hearer}_{u_{1,0-3}} & : \textit{Ind} \\ \text{cat}_{u_{1,0-3}} & : [\text{V}, +\text{fin}] \end{array} \right]$$

$$\left( \begin{array}{ll} \text{msg}_{u_{1,0-3}} & : \text{?leave}(\text{ref}_{u_{1,1-2}}, \text{ev-time}_{u_{1,0-3}}) \\ \text{cont}_{u_{1,0-3}} & : \text{ask}(\text{sp}_{u_{1,0-3}}, \text{hearer}_{u_{1,0-3}}, \text{msg}_{u_{1,0-3}}) \end{array} \right)$$

Suppose your context is defective - you don't have a referent  
for  $_1$  Bo  $_2$

$$\lambda r : \left[ \begin{array}{ll} \text{phon}_{u_{1,0-1}} & : \text{/dId/} \\ \text{phon}_{u_{1,1-2}} & : \text{/bu/} \\ \text{phon}_{u_{1,2-3}} & : \text{/liv/} \\ \text{phon}_{u_{1,0-3}} & : \text{/dIdbulív/} \\ \text{utt-time}_{u_{1,0-3}} & : \textit{Time} \\ \text{ev-time}_{u_{1,0-3}} & : \textit{Time} \\ \text{tense}_{u_{1,0-3}} & : \text{ev-time}_{u_{1,0-3}} < \text{utt-time}_{u_{1,0-3}} \\ \text{ref}_{u_{1,1-2}} & : \textit{Ind} \\ \text{res}_{u_{1,1-2}} & : \text{named}(\text{ref}_{u_{1,1-2}}, \text{"Bo"}) \\ \text{sp}_{u_{1,0-3}} & : \textit{Ind} \\ \text{hearer}_{u_{1,0-3}} & : \textit{Ind} \\ \text{cat}_{u_{1,0-3}} & : [\text{V}, +\text{fin}] \end{array} \right]$$

$$\left( \left[ \begin{array}{ll} \text{msg}_{u_{1,0-3}} & : \text{?leave}(\text{ref}_{u_{1,1-2}}, \text{ev-time}_{u_{1,0-3}}) \\ \text{cont}_{u_{1,0-3}} & : \text{ask}(\text{sp}_{u_{1,0-3}}, \text{hearer}_{u_{1,0-3}}, \text{msg}_{u_{1,0-3}}) \end{array} \right] \right)$$

# Coercion 1 – Lowering

## Existential quantification of deficient parameters

She's asking whether somebody named Bo left

$$\lambda r : \left[ \begin{array}{ll} \text{phon}_{u_{1,0-1}} & : /dId/ \\ \text{phon}_{u_{1,1-2}} & : /bu/ \\ \text{phon}_{u_{1,2-3}} & : /liv/ \\ \text{phon}_{u_{1,0-3}} & : /dIdbulív/ \\ \text{utt-time}_{u_{1,0-3}} & : \textit{Time} \\ \text{ev-time}_{u_{1,0-3}} & : \textit{Time} \\ \text{tense}_{u_{1,0-3}} & : \text{ev-time}_{u_{1,0-3}} < \text{utt-time}_{u_{1,0-3}} \\ \text{sp}_{u_{1,0-3}} & : \textit{Ind} \\ \text{hearer}_{u_{1,0-3}} & : \textit{Ind} \\ \text{cat}_{u_{1,0-3}} & : [\text{V}, +\text{fin}] \end{array} \right]$$
$$\left( \begin{array}{ll} \text{ref}_{u_{1,1-2}} & : \textit{Ind} \\ \text{res}_{u_{1,1-2}} & : \text{named}(\text{ref}_{u_{1,1-2}}, \text{“Bo”}) \\ \text{msg}_{u_{1,0-3}} & : ?\text{leave}(\text{ref}_{u_{1,1-2}}, \text{ev-time}_{u_{1,0-3}}) \\ \text{cont}_{u_{1,0-3}} & : \text{ask}(\text{sp}_{u_{1,0-3}}, \text{hearer}_{u_{1,0-3}}, \text{msg}_{u_{1,0-3}}) \end{array} \right)$$

## 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”?

$$\lambda r : \left[ \begin{array}{ll} \text{phon}_{u_1,0-1} & : /dId/ \\ \text{phon}_{u_1,1-2} & : /bu/ \\ \text{phon}_{u_1,2-3} & : /liv/ \\ \text{phon}_{u_1,0-3} & : /dIdbulív/ \\ \text{utt-time}_{u_1,0-3} & : \textit{Time} \\ \text{ev-time}_{u_1,0-3} & : \textit{Time} \\ \text{tense}_{u_1,0-3} & : \text{ev-time}_{u_1,0-3} < \text{utt-time}_{u_1,0-3} \\ \text{sp}_{u_1,0-3} & : \textit{Ind} \\ \text{hearer}_{u_1,0-3} & : \textit{Ind} \\ \text{cat}_{u_1,0-3} & : [V, +\text{fin}] \\ \text{phon}_{u_2,0-1} & : /bu \text{ L-H}/ \\ \text{utt-time}_{u_2,0-1} & : \textit{Time} \\ \text{sp}_{u_2,0-1} & : \textit{Ind} \\ \text{hearer}_{u_2,0-1} & : \textit{Ind} \end{array} \right]$$

$$\left( \text{msg}_{u_2,0-1} : ? \lambda r' : \left[ \begin{array}{ll} \text{ref}_{u_1,1-2} & : \textit{Ind} \\ \text{res}_{u_1,1-2} & : \text{named}(\text{ref}_{u_1,1-2}, \text{“Bo”}) \\ & (\text{ref}(u_{1.1-2}, \text{ref}_{u_1,1-2})) \end{array} \right] \right)$$

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?*)

$$\lambda r : \left[ \begin{array}{ll} \text{phon}_{u_{1,0-1}} & : \text{/dId/} \\ \text{phon}_{u_{1,1-2}} & : \text{/bu/} \\ \text{phon}_{u_{1,2-3}} & : \text{/liv/} \\ \text{phon}_{u_{1,0-3}} & : \text{/dIdbulív/} \\ \text{utt-time}_{u_{1,0-3}} & : \textit{Time} \\ \text{ev-time}_{u_{1,0-3}} & : \textit{Time} \\ \text{tense}_{u_{1,0-3}} & : \text{ev-time}_{u_{1,0-3}} < \text{utt-time}_{u_{1,0-3}} \\ \text{ref}_{u_{1,1-2}} & : \textit{Ind} \\ \text{res}_{u_{1,1-2}} & : \text{named}(\text{ref}_{u_{1,1-2}}, \text{“Bo”}) \\ \text{sp}_{u_{1,0-3}} & : \textit{Ind} \\ \text{hearer}_{u_{1,0-3}} & : \textit{Ind} \\ \text{cat}_{u_{1,0-3}} & : [\text{V}, +\text{fin}] \\ \text{phon}_{u_{2,0-1}} & : \text{/bu L-H/} \\ \text{utt-time}_{u_{2,0-1}} & : \textit{Time} \\ \text{sp}_{u_{2,0-1}} & : \textit{Ind} \\ \text{hearer}_{u_{2,0-1}} & : \textit{Ind} \end{array} \right]$$

$$\left( \left[ \begin{array}{ll} \text{max-QUD}_{u_{2,0-1}} & : ? \lambda x : \textit{Ind} (\text{ask}(\text{sp}_{u_{1,0-3}}, \text{hearer}_{u_{1,0-3}}, ?\text{leave}(x, \text{ev-time}_{u_{1,0-3}}))) \\ \text{cont}_{u_{2,0-1}} & : ?\text{ask}(\text{sp}_{u_{1,0-3}}, \text{hearer}_{u_{1,0-3}}, ?\text{leave}(\text{ref}_{u_{1,1-2}}, \text{ev-time}_{u_{1,0-3}})) \end{array} \right] \right)$$

## 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