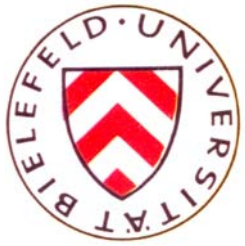

SDRT and Multi-modal Situated Communication

Andy Lücking, Hannes Rieser, Marc Staudacher

Outline

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Communicators

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1. Motivation
2. Exposition of Standard SDRT
3. Recent SDRT Developments
4. Representation of Situated Content in SDRT
5. SDRT as MM Interface
6. Conclusions

1. Motivation

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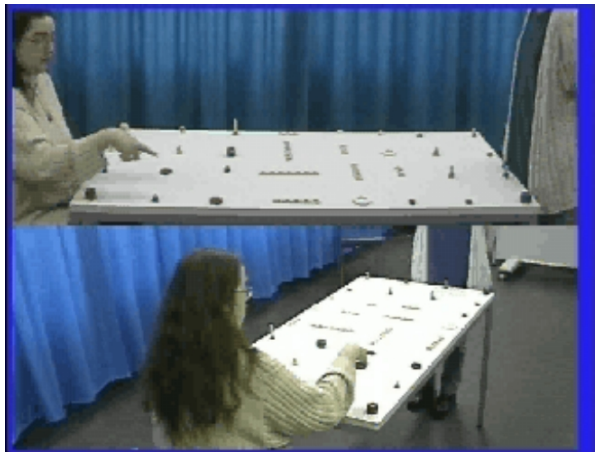
Language use in situated communication differs from other kinds of communication.

- **Compare:**
  i. World economic growth slowed noticeably in 2005 from the strong expansion in 2004.
  ii. (1) I: The red $\searrow_a$ wooden disc.
  (2) C: $\downarrow\downarrow_a$ This one?
  (3) I: Yes.
- **Characteristics:**
  – Non-sentential utterances
  – Nonverbal behaviour
  – Non-sentential utterances perform dialogue moves and express sentential content.
- **Frequent use of fragments**: In our corpus (see Lücking and Stegmann (2005), p. 15) 50 instructor's requests were realized as definite NPs out of a total of 92 dialogue moves including acceptances and repairs.



1. Aims

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- **Goal:** Develop theory of situated communication
- **Requirement:** The theory must explain, given the use of non-sententials and nonverbal behaviour,
  - which dialogue moves are performed and
  - which sentential contents are communicated.

- **Observation 1:** Pointing (demonstration) contributes to the meaning of an NP.
- **Observation 2:** Graspings contribute to the communicative meaning of a dialogue.
- **Observation 3:** Grounding of reference of multi-modal utterances is important for success of dialogue games.

➢ Theory must account for observations 1 to 3.

1. Related Research

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- **Gestures:**
  Kopp, Tepper, and Cassell (2004), Kranstedt, Lücking, Pfeiffer, Rieser, Staudacher (2006), McNeill (1992), Rieser (2004, 2005), van der Sluis and Krahmer (2004), van der Sluis (2005).

- **Fragments:**
  Elugardo and Stainton (eds., 2005), Poncin and Rieser (2000, 2006),Purver and Kempson (2004), Purver, Cann and Kempson (2005), Schegloff (1979), Skuplik (1999), Schlangen and Lascarides (2003).

- **Dialogue, Discourse, Dynamics:**
  Asher (2002, 2005), Asher and Lascarides (2003), Garrod and Pickering (2004), Kamp (1990), Muskens (1996, 2001), Poesio and Traum (1997).

1. Plan

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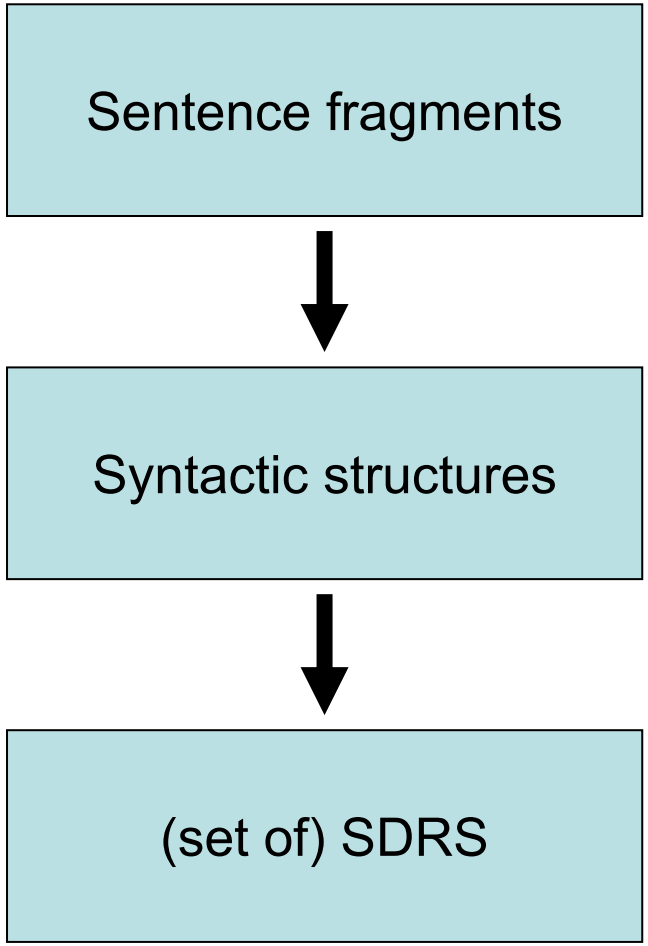
- We use SDRT as our framework. The concepts doing the explanatory work are introduced next.
- We won't say much about the mapping from NL to syntax. Though we propose to use LTAG there.
- We don’t treat fragments as sentences.

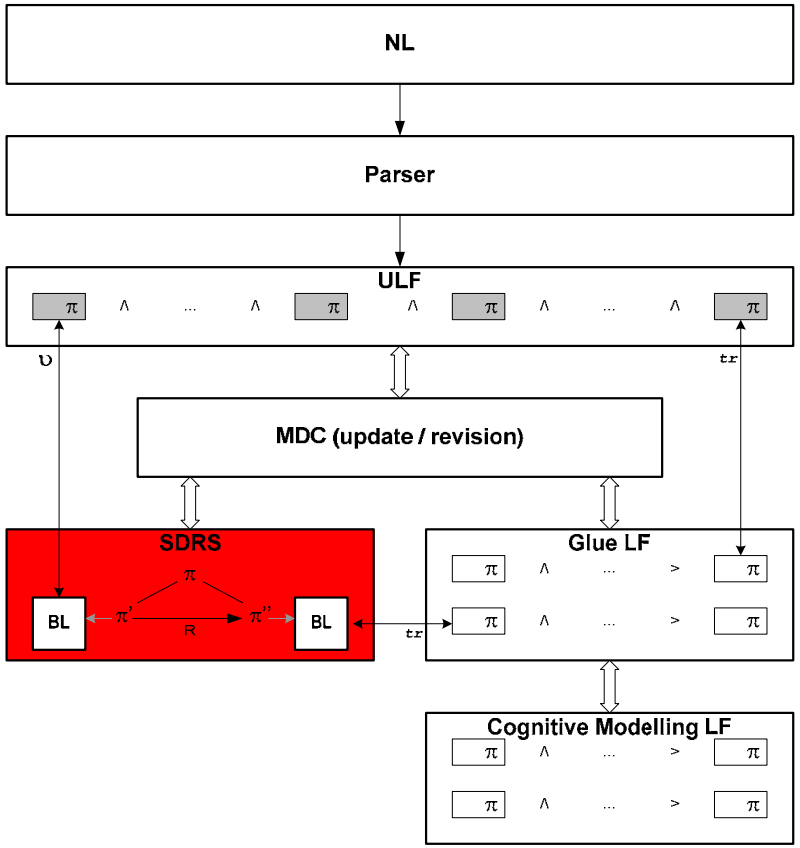


2. Exposition of Standard SDRT

- Start: Asher & Lascarides: *Logics of Conversation*, 2003.
- **How SDRT works, a**pplying it to example ii.:

1. Assume initial context C which contains the SDRSs described by the **ULF** of *(1) I: The red* $\searrow_a$ *wooden disc.*
2. Update C with the ULF of *(2) C:* $\downarrow\downarrow_a$ *This one?*.

- Thus (2) is related by some **Discourse Relation** R to some **Attachment Point** X. In this case the only/most coherent one is *(1)*.
- However, Discourse Relations only relate content having (sentential) satisfaction conditions. Standard SDRT fails with sub-sententials.



2. Exposition of Standard SDRT

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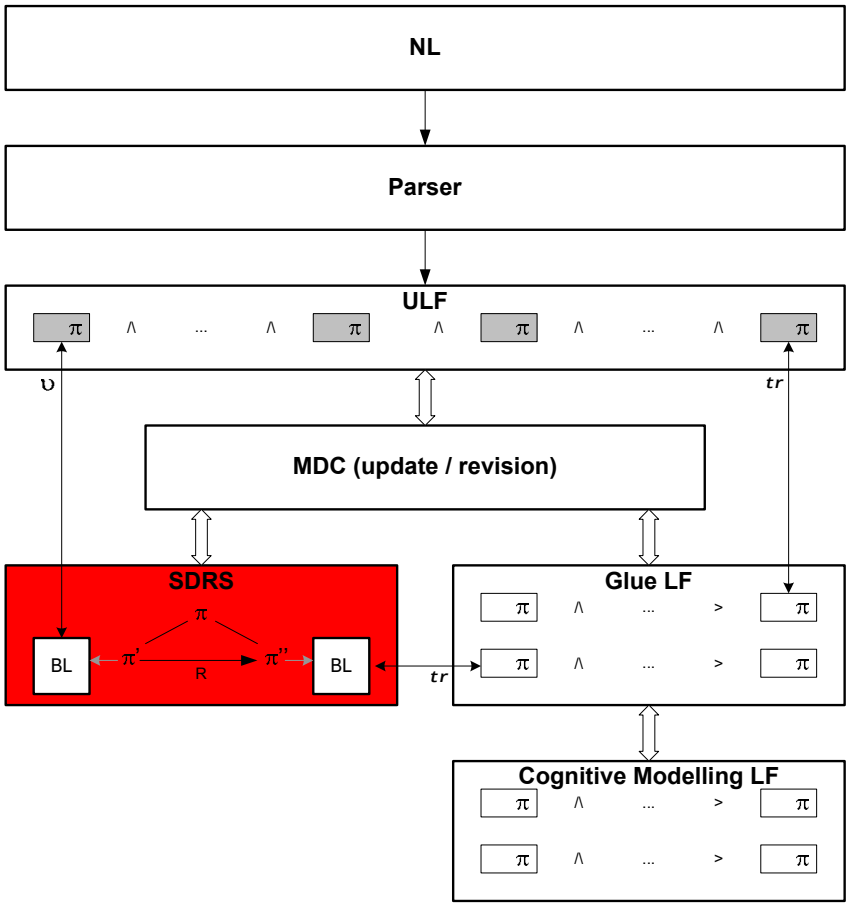
(Assume ii. had sentential content)

- The ULF of *(2) C:* $\downarrow\downarrow_a$ *This one?* is translated to **Glue** and to **Cognitive Modelling** in order to resolve underspecification by **pragmatic reasoning**.
- The results of the reasoning are translated back to ULF and added to the description of the new context C'. **update** restricts the resolutions to those that are consistent.

3. Apply **best-update** to *(3) I: Yes*. Best-update is like update but it ranks the SDRSs in the final context C'' by applying **MDC**.



2. Exposition of Standard SDRT

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- Standard SDRT cannot handle fragments, since ULFs are expected to describe Base Logical Forms of complete sentences.
  - We would like to establish that Q-Elab(1,2) holds by pragmatic reasoning.
  - However, in Standard SDRT, Discourse Relations cannot relate non-sentential content.
  - Idea (not followed here): Construct sentential content from non-sentential content.

3. Recent SDRT Developments

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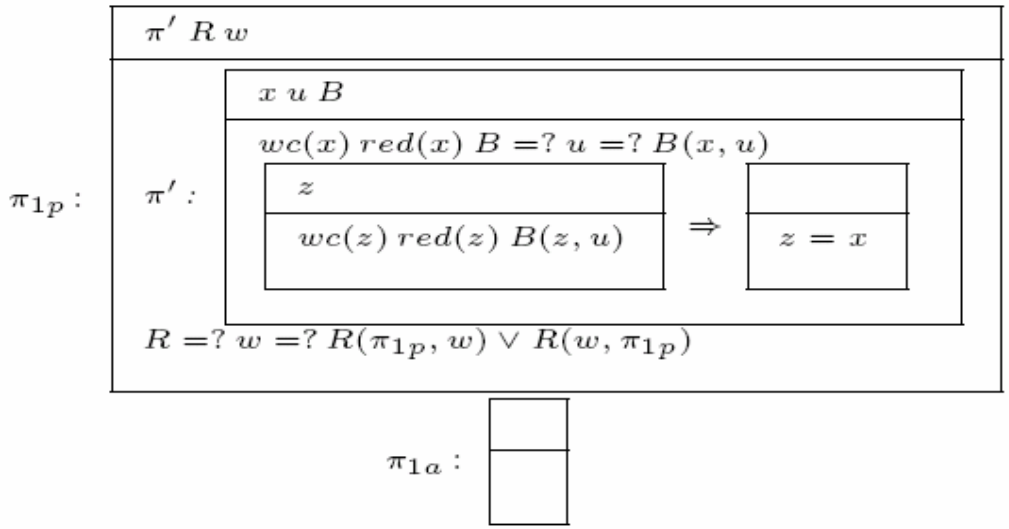
Representation of NPs:

- Distinguish between presupposed and asserted information.
- Definite NPs introduce a **Bridging relation** holding between the NP's referent and some contextually given antecedent.

Example: (1) *The red wooden disc!*



3. Recent SDRT Developments

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Anchoring:

- Deicitically used definites **anchored** to some object in non-linguistic context.
- Such a definite involves a ***de re* attitude towards the object**, some sort of *knowing how* needed to solve the Speech Act Related Goals (SARGs) of the speaker.
- If an **Anchoring Relation** holds between a definite uttered by an agent A and some Attachment Point in the discourse, then A is supposed to have a computable means of getting to the referent of the definite from the present non-linguistic context of utterance under some given purpose P.
- **Anchoring amounts to coordination or alignment**: If the anchoring function of a deictically used definite is accepted by the participants in dialogue, they are assumed to mutually believe that the definite picks out the same object for them.

(see Asher (2002))

3. Recent SDRT Developments

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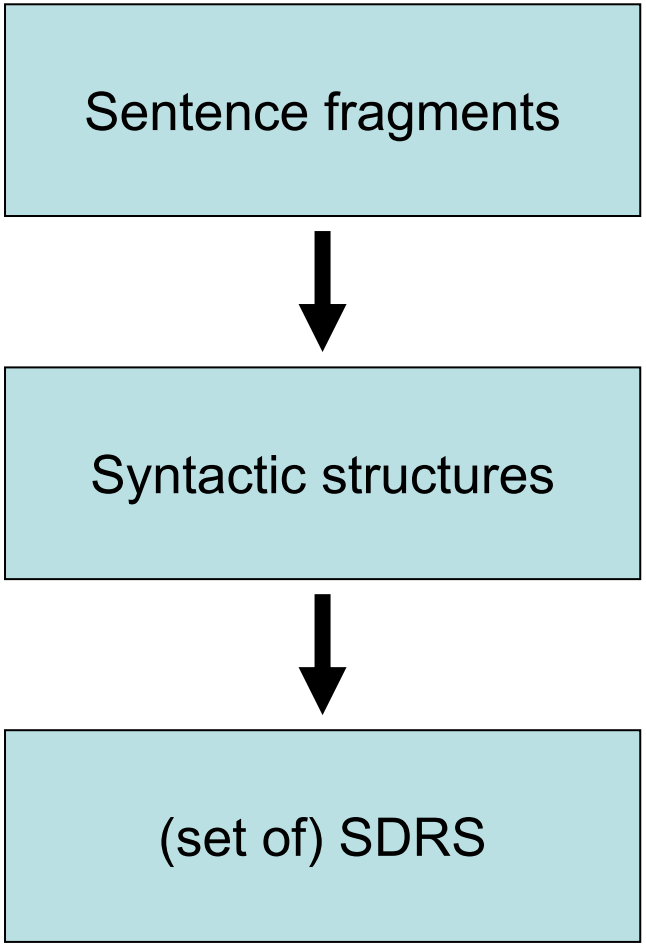
- Lascarides / Schlangen treat fragments differently, using HPSG and MRS.
- Fragments are assigned a "S-frag" category, in essence an XP.
- "S-frag" is interpreted in an inter-mediate language as "P([XP])" where [XP] is the compositional meaning of the XP (e.g. *the red wooden disc*) and P is some underspecified property.
- We think that fragments have only their compositional meaning.
- How a fragment's sentential content is constructed out of [XP] needs to be addressed in any case.



4. Representation of Situated Content in SDRT (1)

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Empirical Findings from two MM Corpora:

- In **situations of certain types** special conventions hold. They are mutually believed/known by the agents involved.
- The conventions are **special** because **they hold relative to situations of a certain type** (and not in all situations). Special conventions are paired with situation types.
- **Situation types are partially characterized** by agents, domains, agents' intentions and plans, appropriate actions (verbal and non-verbal), rights and obligations, and aims.
- **Observation:** Frequently, appropriate actions are referred to using typical verbs, e.g. *put, screw, plug* or locutions (**routinization**).

4. Representation of Situated Content in SDRT (2)

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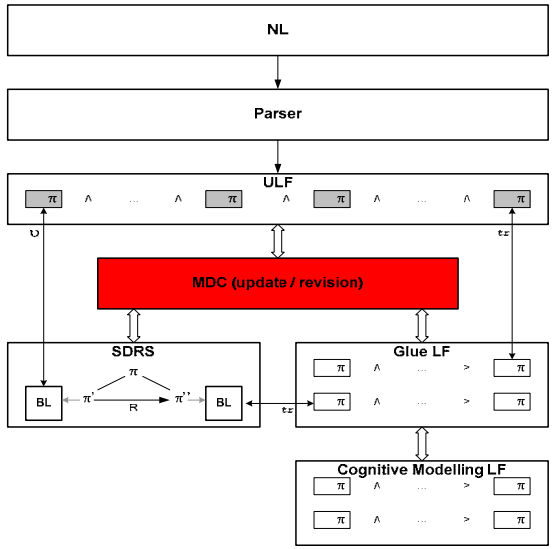
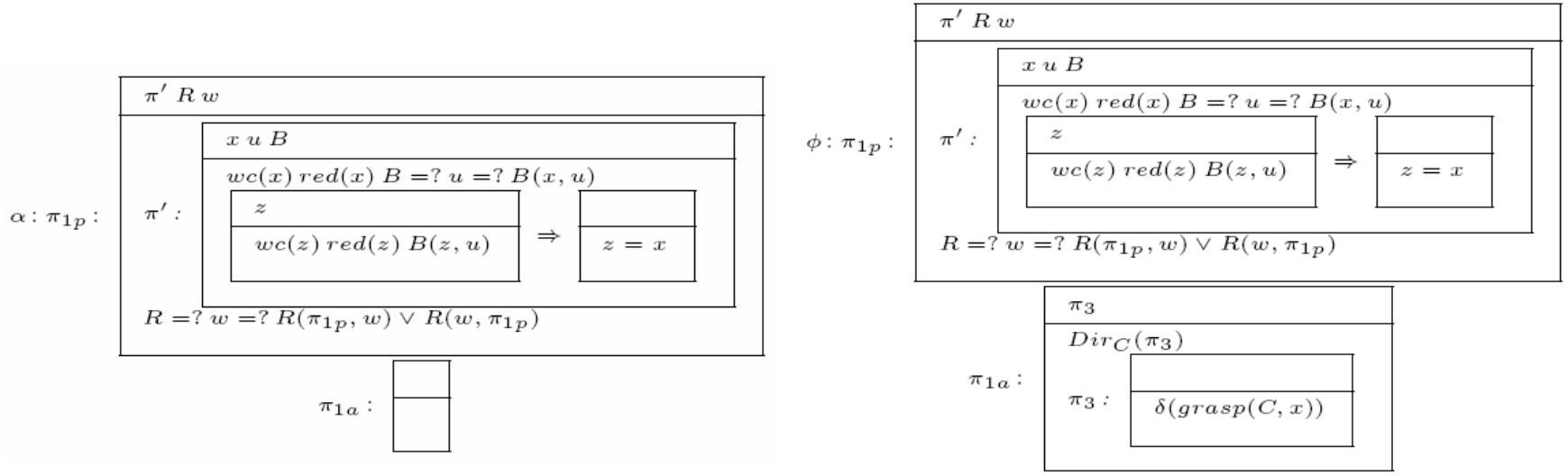
- For SDRT this means that the **conventions holding in a context** are introduced into **Cognitive Modelling theory**.
- The Cognitive Modelling theory also contains a description of the participants' utterances.
- So, the conventions plus the utterances can be used to derive what the participants have communicated.
- For our example, there exists such a special convention: If the Agent of (1) has uttered *The red wooden disc*, then he has commanded that C grasp the object pointed at.



$$\mathcal{K}_{I,C}(\alpha(\pi_1) \wedge Ag(\pi_1) = I \wedge (\mathcal{MB}_{I,C}(\alpha(\pi_1) \wedge Ag(\pi_1) = I) \rightarrow Say_I(p_\phi))) \rightarrow \alpha(\pi_1) \text{ resolves to } \phi$$

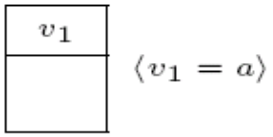
4. Representation of Situated Content in SDRT (3)

The existence of such conventions plus the Cognitive Modelling Logic allow to derive Φ from α:

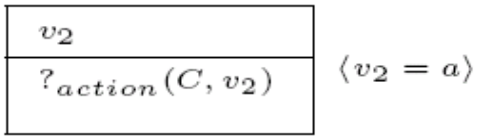


4. Representation of Situated Content in SDRT (4)

- **Demonstrations** anchor Discourse Referents to objects and have no meaning beyond that.



- **Graspings** also have meaning, but an underspecified one. They have a content of the type of an action.They also anchor Discourse Referents to objects.



5. SDRT as an MM Interface (1)

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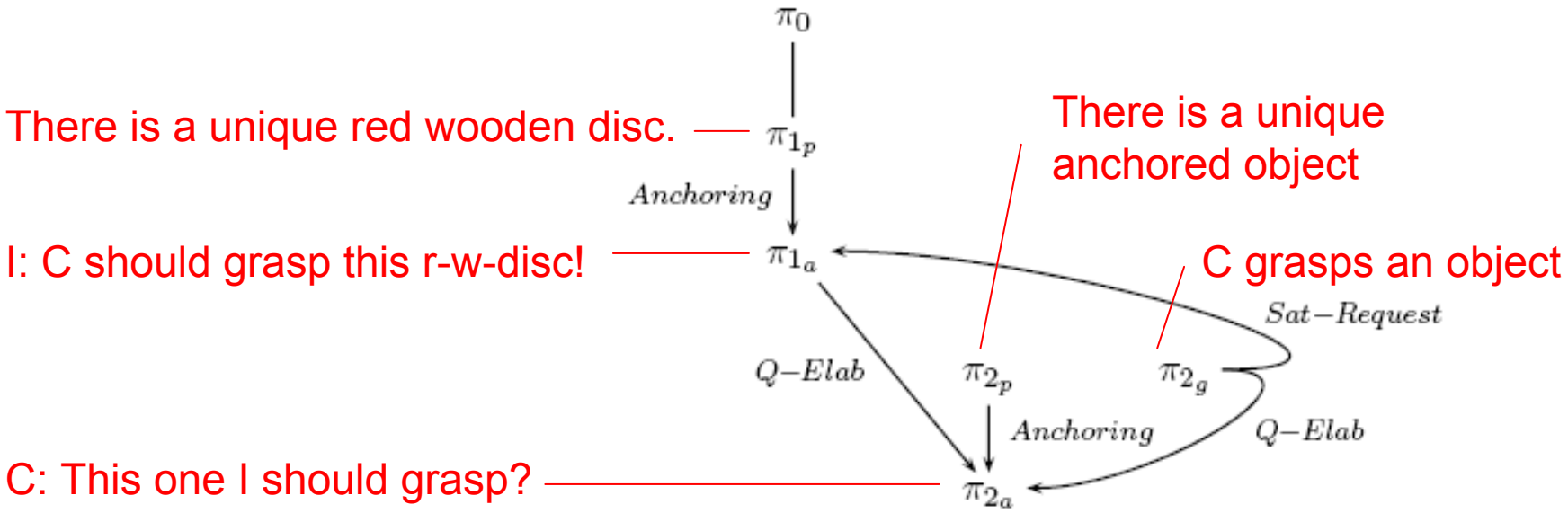
Discourse structure of

ii. (1) I: The red $\searrow_a$ wooden disc.
(2) C: $\downarrow\downarrow_a$ This one?



5. SDRT as an MM Interface (2)

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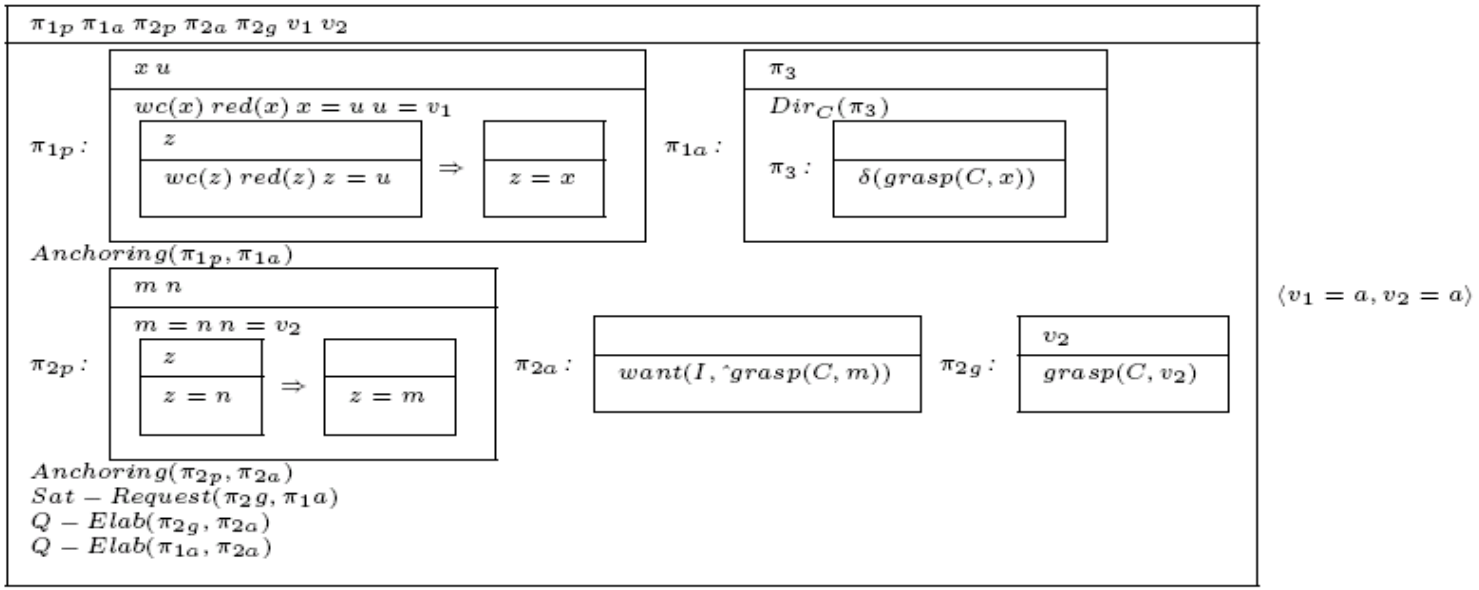
By applying MDC we get:

- The maximal specific content (= smallest model)
- Resolving the Bridging Relation to identity
- Resolving and maximizing the number of Discourse Relations
- Anchoring and minimizing the number of Discourse Referents



6. Conclusions

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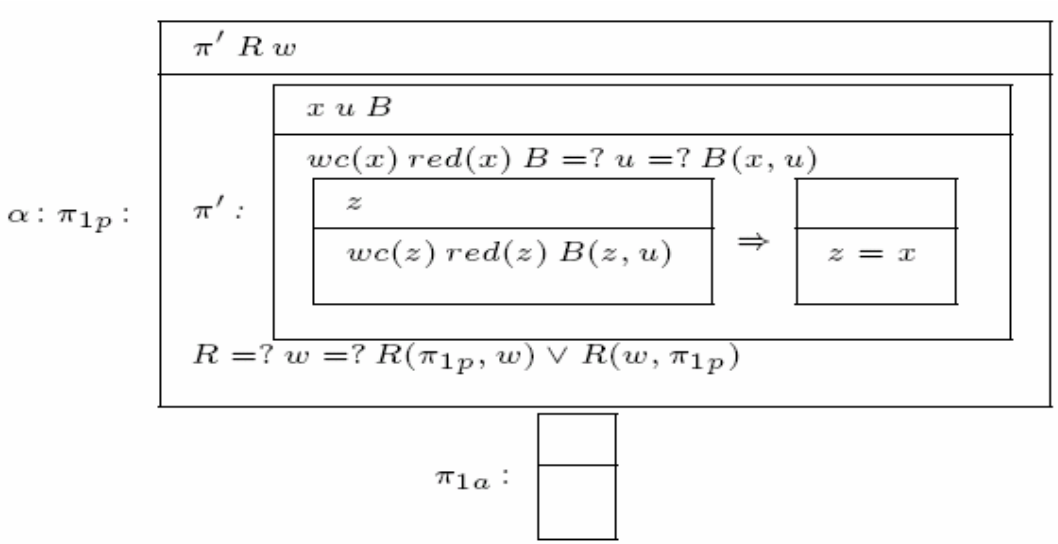
- **Things done**
  - First sketch of a theory of situated communication by means of **SDRT + special conventions** used to determine the communicative meaning of non-sentential utterances.
  - Relating gestures to NPs by **presupposition representation**, **Anchoring** and **MDC**.
- **Loose ends**
  - Alternative representations of graspings
  - Statistical investigation concerning fragments of dialogue moves
  - Coverage results for special convention(s)
  - Generalizability
- **Future research**
  - Clear distinction between different cases of fragments (syntax based explanation *vs.* pragmatic explanation)
  - Addressing loose ends

A1. Construction of Dialogue ii.

(1) I: The red wooden disc

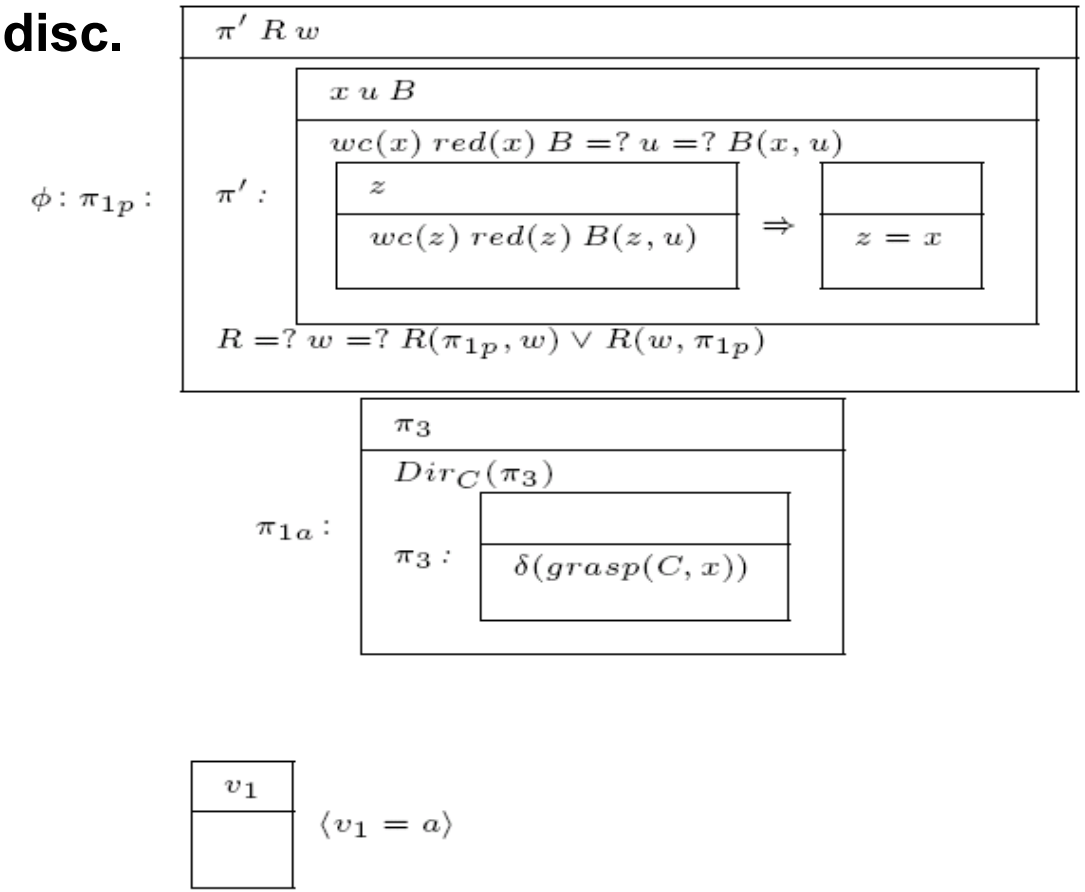
- Representation of presupposition
- DRT-style representation of definite description
- Underspecified content in presupposition:
  - Bridging relation,
  - discourse relation,
  - DRs.
- No content embedding the presupposition.



A2. Construction of Dialogue ii.

(1) I: The red $\searrow_a$ wooden disc.

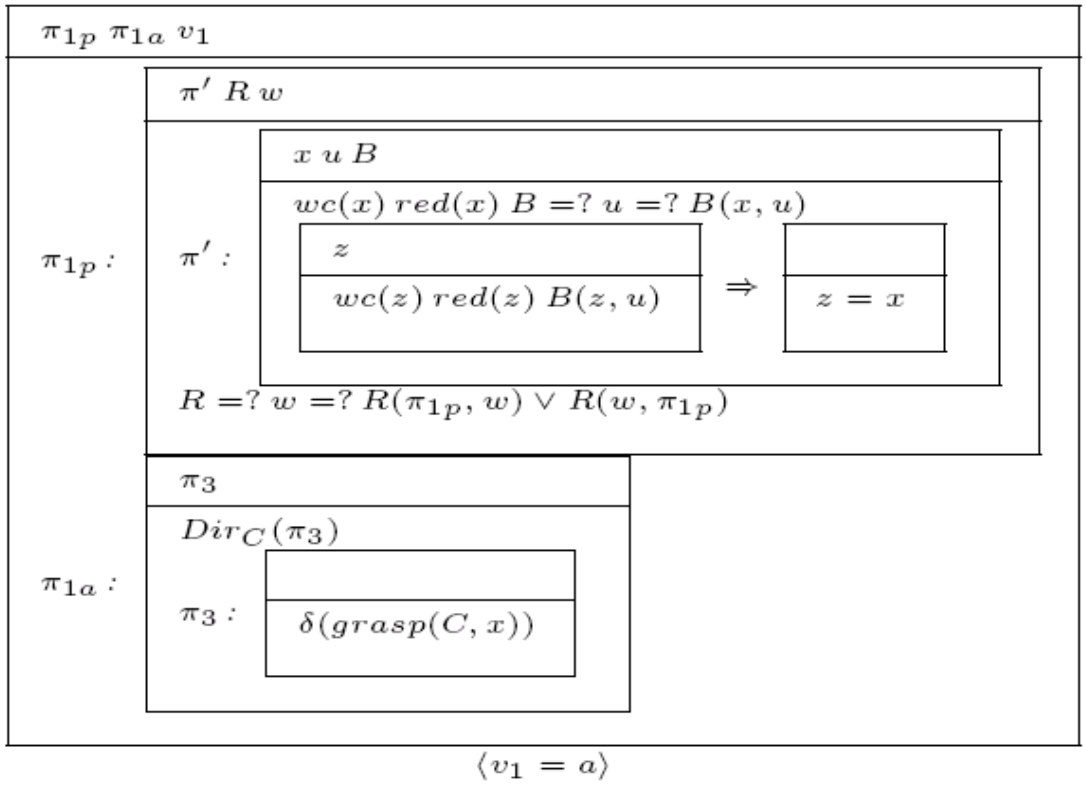
- Content of directive due to the convention which is part of the context as are the words uttered.
- The content of the demonstration is provided by an anchor to an external object.



A3. Construction of Dialogue ii.

(1) I: The red ↘$_a$ wooden disc.

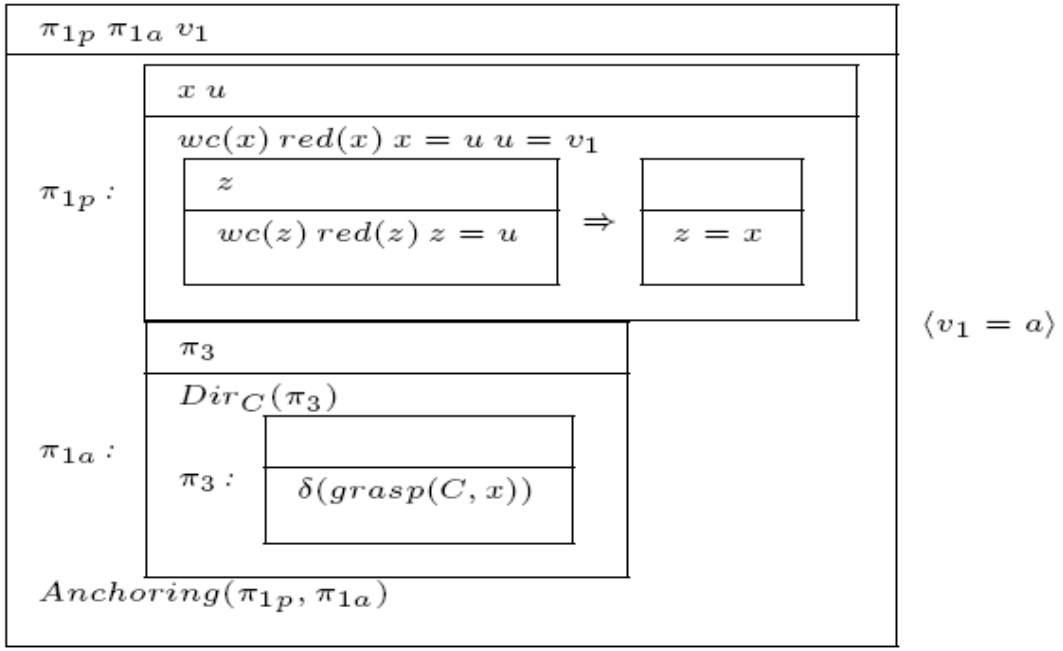
- Presupposed and asserted information
- Underspecified content in presupposition:
  - Bridging relation,
  - discourse relation,
  - DRs.
- Demonstration yields anchor to external object with widest scope given to DR.
- Content of directive due to the convention which is part of the context as are the words uttered.



A4. Construction of Dialogue ii.

(1) I: The red ↘$_a$ wooden disc.

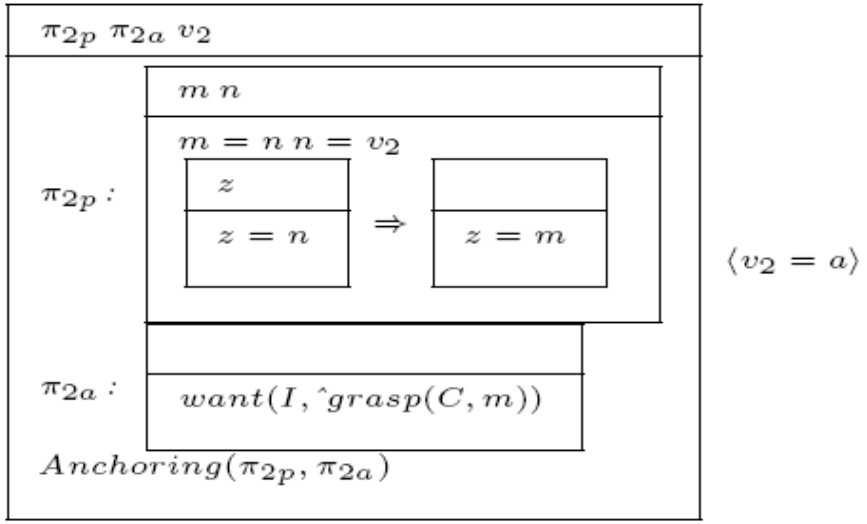
- Presuppositional information and content of the directive are linked by the discourse relation of Anchoring.

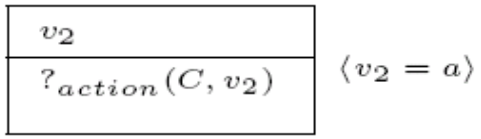


A5. Construction of Dialogue ii.

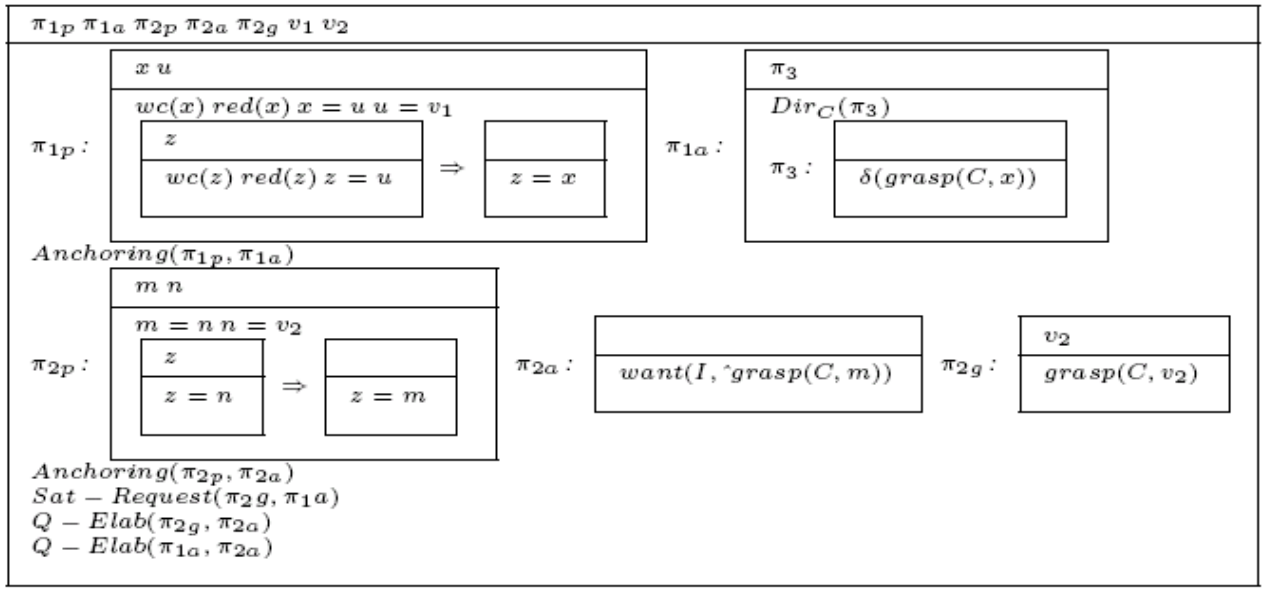
(2) C: $\downarrow\downarrow_a$ This one?

- C's check-back consists of a definite NP and a concurrent grasping.
- The DR in the definite NP is anchored to an external object.
- Content of the question is reconstructed.
- C's grasping is given the underspecified content of an action.
- The action's target is the external object.





A6. Construction of Dialogue ii.



- Propositions are anchored by their presuppositions.
- C's action is instantiated by a grasping relation.
- Demonstration and grasping are anchored to the same object.
- C's grasping satisfies I's request.
- Two Q-Elab relations are established.