Feedback in conversation as incremental semantic update

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Outline

- Grounding in interaction: Backchannels, Clarification Requests
- (Very) short introduction to Dynamic Syntax and Type Theory with Records (DS-TTR)
- A model of Backchannels and Clarification Interaction in DS-TTR
- Discussion: comparison to other models
- Concluding Remarks

Grounding in Dialogue

- Dialogue involves joint, coordinated action, much like a dance
- Speaker & hearer are not autonomous; hearers are not passive but shape discourse (Bavelas et. al.)
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- Cross-turn **Context-dependency** is a key resource for signalling grounding

Backchannels

- Feedback that does not constitute a turn - verbal like ‘mhm’ or non-verbal like nodding
- Multi-functional, ambiguous - not just signalling understanding
- *During ongoing sentences/turns*:

Examples

British National Corpus (BNC) KPU:

Gearoid	It’s about these two chaps living in New York ⟨pause⟩ one is American and the other is er ⟨pause⟩ Hong Kong, no Chinese ⟨pause⟩ and they’re an affair, they’re [living]
Anne-Marie	[Mm].
Gearoid	together, very [sort of]
Anne-Marie	[Mm].
Gearoid	you know, kind, one is an architect and the other ⟨pause⟩ the Chinese guy is a property dealer.

Incremental Clarification

- Feedback can also be negative in the form of Clarification Requests (CR)
- And can also occur before a sentence/proposition is complete:

Examples

(BNC) KPY

A	1006	Er, the doctor
B	1007	Chorlton?
A	1008	Chorlton, mhm, he examined me, erm, he, he said now they were on about a slide ⟨unclear⟩ on my heart.

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- Word-by-word construction of semantic (and contextual) representations in Type Theory with Records (TTR, Cooper (2012); Purver et. al., 2010; Eshghi et. al, 2013)
- syntax = **constraints** on incremental semantic construction
- grammar = set of **conditional actions** for incremental, **semantic** update
  - Computational Actions: general tree-building operations, e.g. COMPLETION, BETA-REDUCTION
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- DS is bidirectional - generation uses exactly the same mechanisms/representations as parsing
- Learnable from data (Eshghi et. al. 2013)

Parsing “John Fainted” with DS-TTR

- Words:
- Computational Actions:

$$?Ty(t), \blacklozenge$$

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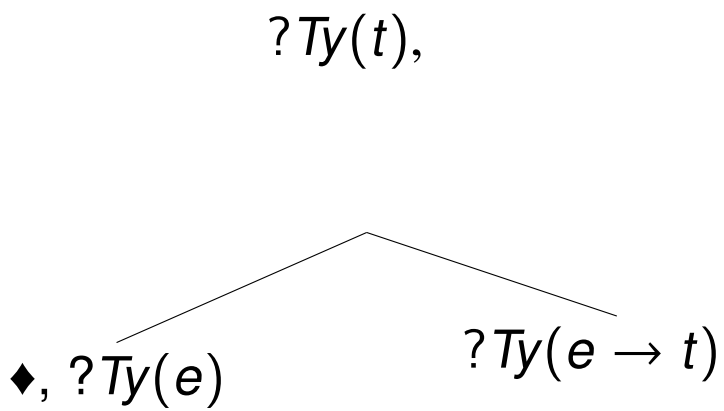

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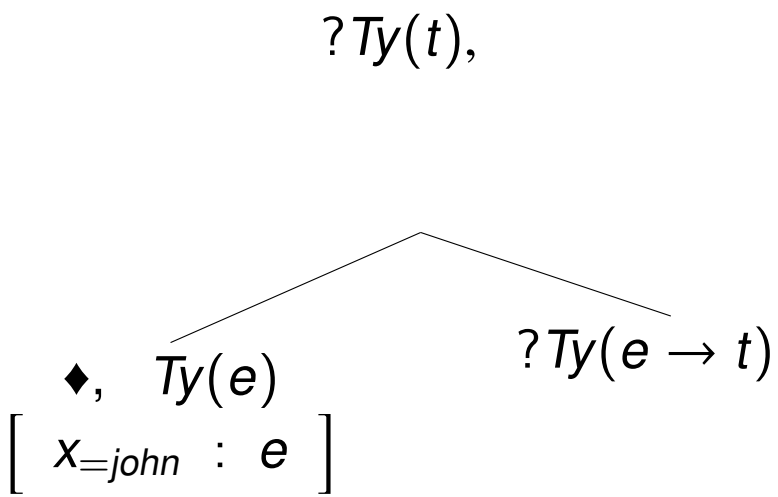

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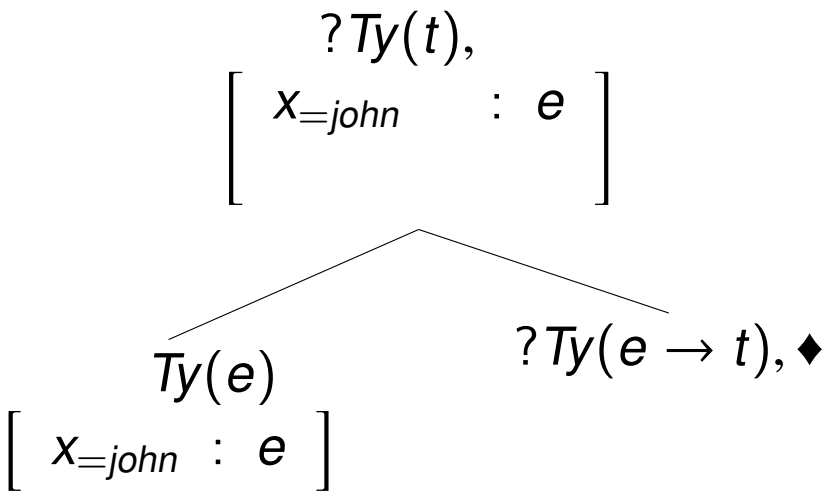

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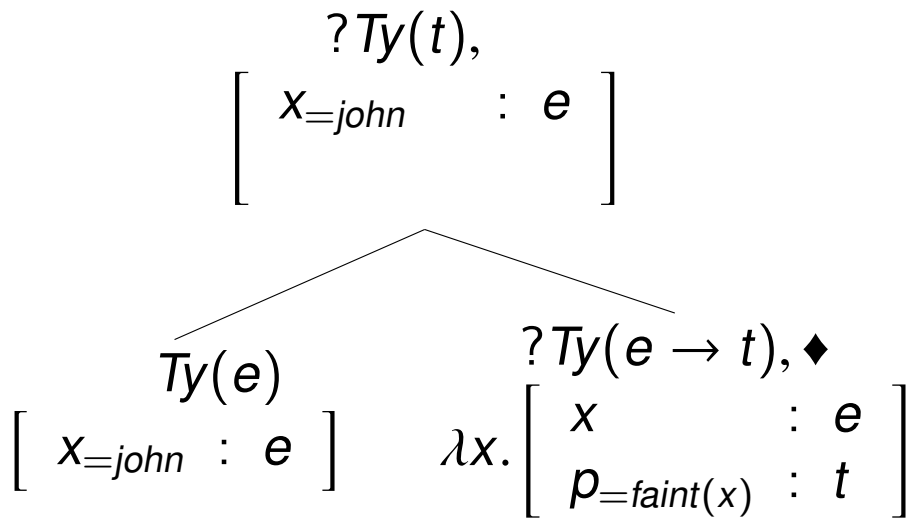

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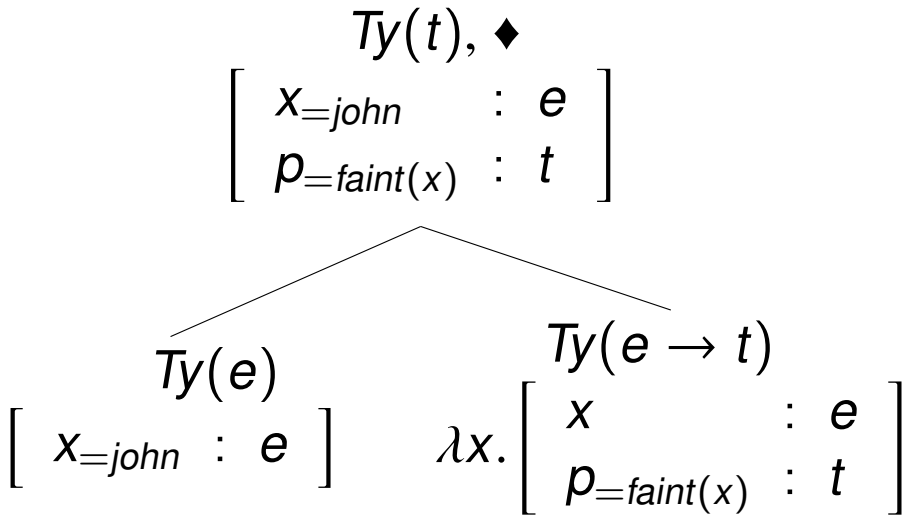
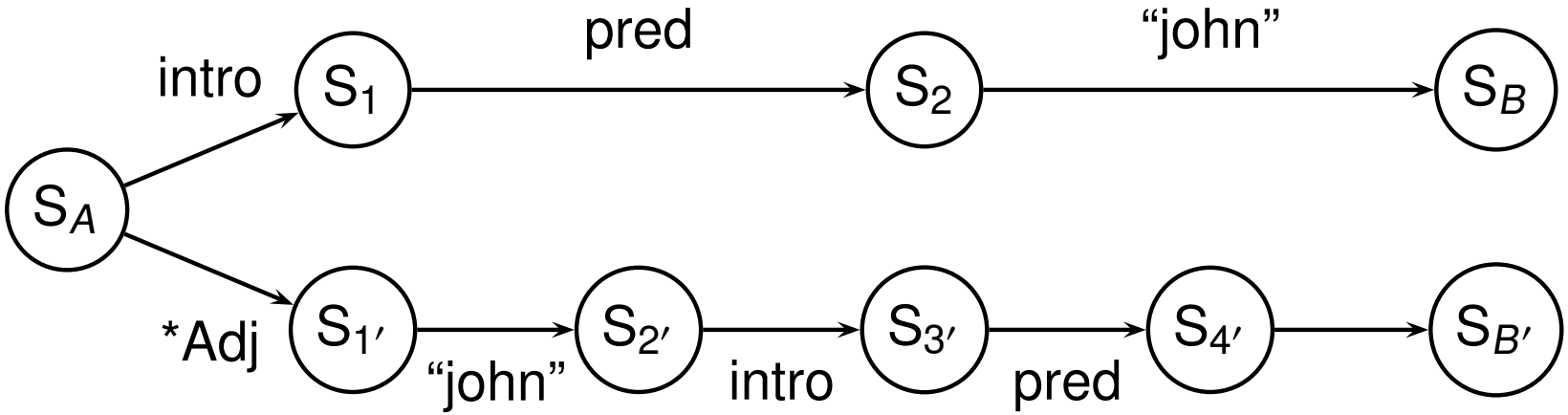


Graph-based parsing and generation



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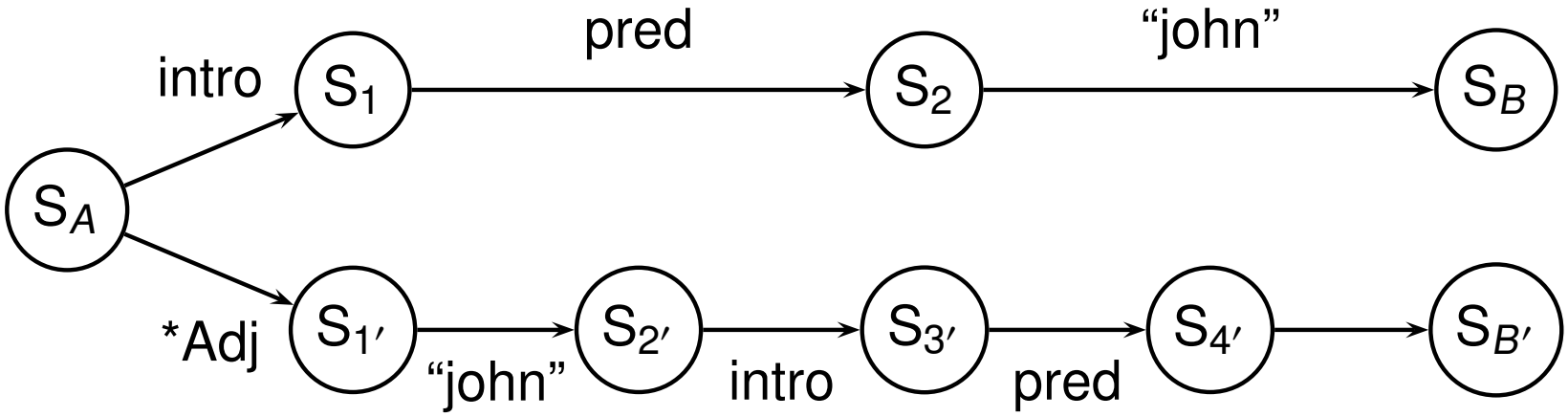

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- Parsing = incremental search/construction of this Directed Acyclic Graph (DAG) (see Sato, 2011)
- Probabilistic best-first parsing definable over the same structure
- Context in DS *is* this DAG: record of trees and actions so far (see Eshghi et. al, 2013; Purver et. al, 2011)
- In a moment: a model of feedback in terms of this DAG

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- Discursive potential (Ginzburg, 2012) or discourse obligation (Matheson et al., 2000) as pointer divergence
- Enables modelling of contextual updates arising from backchannels, CRs, short answers, or any use of context dependency
- .... purely in terms of processing: No recourse to dialogue acts, intentions, or higher order reasoning

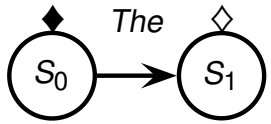
A simple model of backchannels using *coordination pointers*

Self-pointer: ♦
Other-pointer: ◊

Dialogue	**Context-Final Semantics**	**B's Context**

A: The

$$\begin{bmatrix} r & : \begin{bmatrix} x & : e \end{bmatrix} \\ x_{=\iota(r.x,r)} & : e \end{bmatrix}$$



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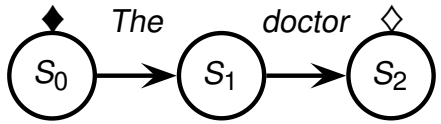

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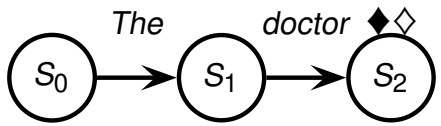

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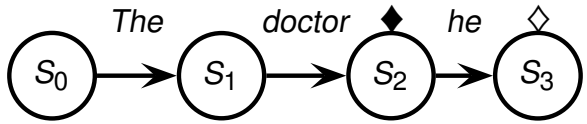

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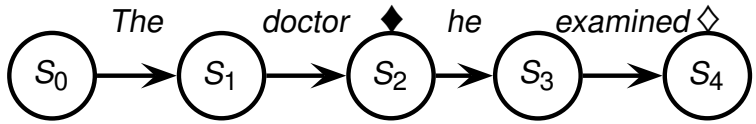

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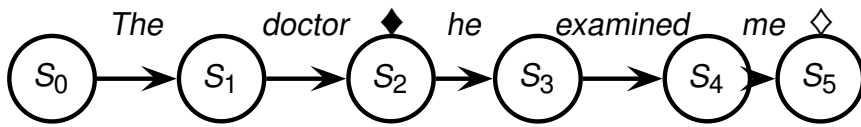

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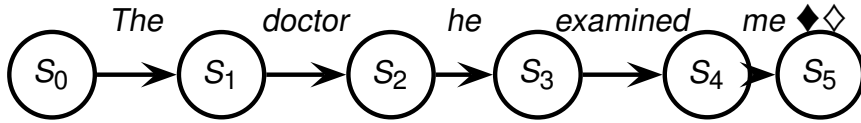

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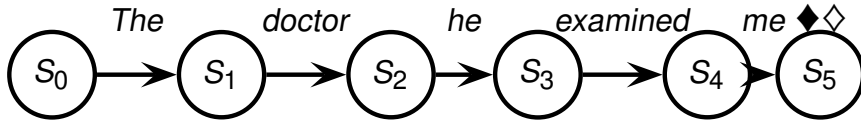

But: This simple account is incomplete: it predicts nothing about the empirical distribution of backchannels (Backchannel-Relevance places)

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- Parsing/Generating a backchannel as triggering COMPLETION
- Reduces parse state ambiguity by eliminating DAG paths incompatible with completion

e.g. in: **A:** Mary, my friend **B:** mhm . . . **A** is less likely to follow up with a relative clause

- This is intuitive but also remains an empirical question
- No need for separate pragmatic rule, or dialogue update function (c.f. Ginzburg, 2012)

Processing Clarification Requests in DS-TTR

- Local and non-local CRs
- *Extend* a semantic tree in context

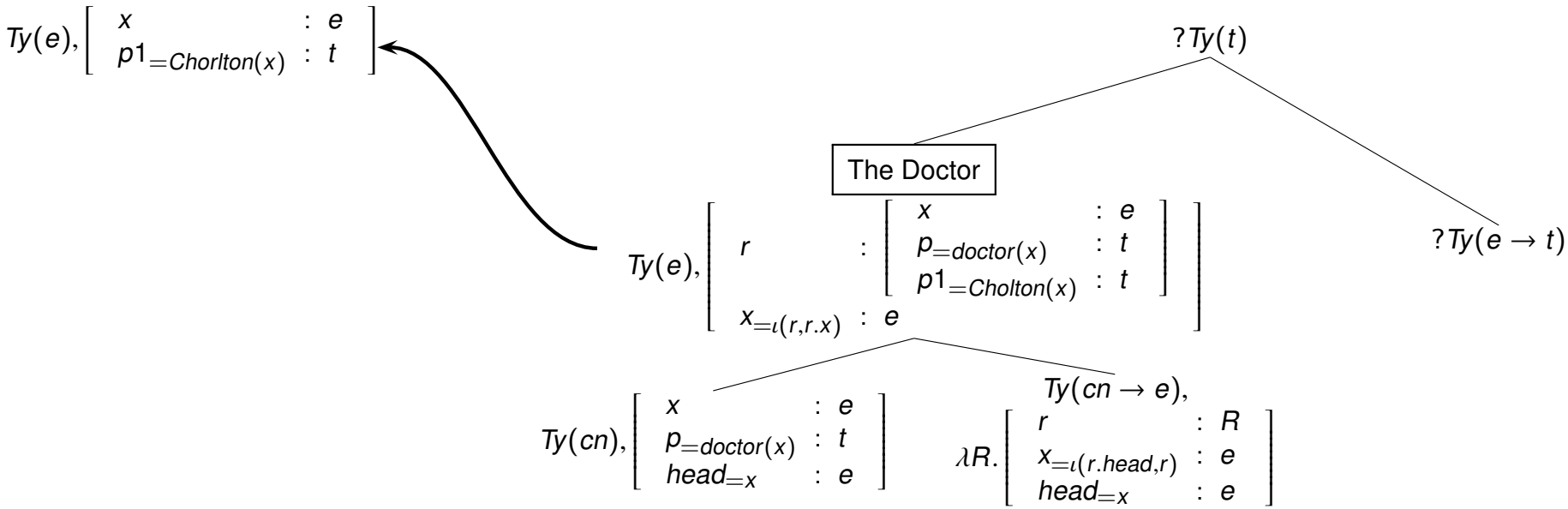

Figure: Processing *Chorlton?* in "A: *the doctor* B: *Chorlton?*"

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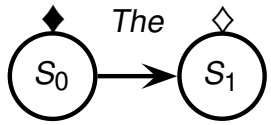

- Mechanisms: Backtracking, re-running actions, extending semantic tree in context
- DS-TTR model of self-repair (Hough, 2015; Hough & Purver, 2014) uses the same mechanisms

Note Rejections/Repair: procedural; not denial of proposition, but abandonment of DAG branch

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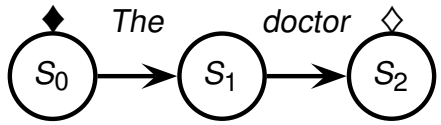

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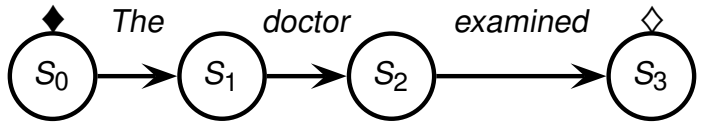

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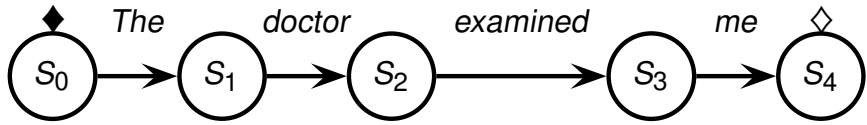

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B: Chorlton?

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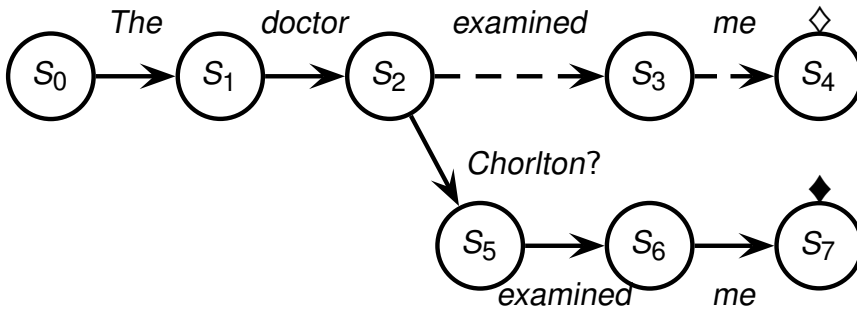

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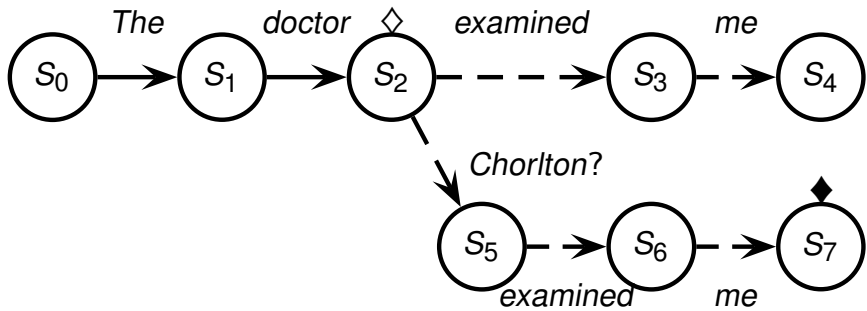
B: Chorlton?

A: no,

$$\begin{bmatrix} r & : & \begin{bmatrix} x & : & e \\ p_{=doctor(x)} & : & t \\ p1 & : & t \end{bmatrix} \\ x_{=\iota(r.x,r)} & : & e \\ ev_{=examine} & : & es \\ p_{=subj(ev,x)} & : & t \\ x1_{=spkr} & : & e \\ p1_{=obj(ev,x1)} & : & t \end{bmatrix}$$



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- Contextual updates arising from the processing of a CR and its response:

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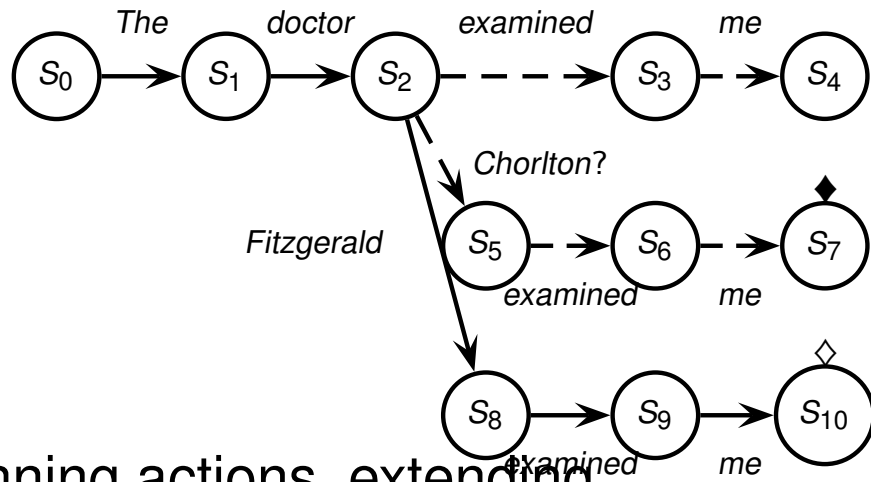

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B: uh-huh

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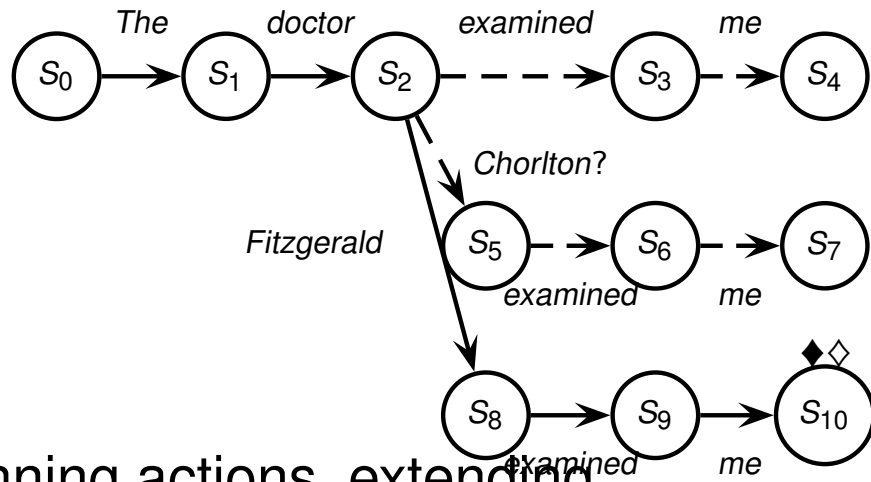

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  - agnostic about pragmatic function of e.g. a backchannel

Concluding Remarks

- We provided a low-level, incremental model of feedback in dialogue as part of the semantic construction process
- Grammar as shared structural resource for building shared understanding
- No recourse to higher level reasoning, dialogue acts, speaker intentions
- Future work: implementation in a spoken dialogue system

Thank you for listening

- Many thanks to Ruth Kempson
- And the anonymous reviewers.
- Questions and criticism welcome