Reminiscing about HCRC and its achievements

Simon Garrod

Some of Keith's bon mots

ESRC rep on HCRC's management structure: *"Looks like a bloody worker's co-operative"*

Keith's response: *"Surely that's better than a worker's uncooperative!"*

Keith on directing HCRC researchers: *"Like trying to herd cats!"*

Interweaving production and comprehension processes in dialogue

Simon Garrod

&

Martin Pickering

# Dialogue: Interweaving production and comprehension

- Challenge of dialogue
- Lessons from action & perception
- Importance of prediction for action/perception
- Interweaving production & comprehension
- Evidence of interweaving
- Evidence for prediction during language processing
- Importance for dialogue

Challenge of dialogue

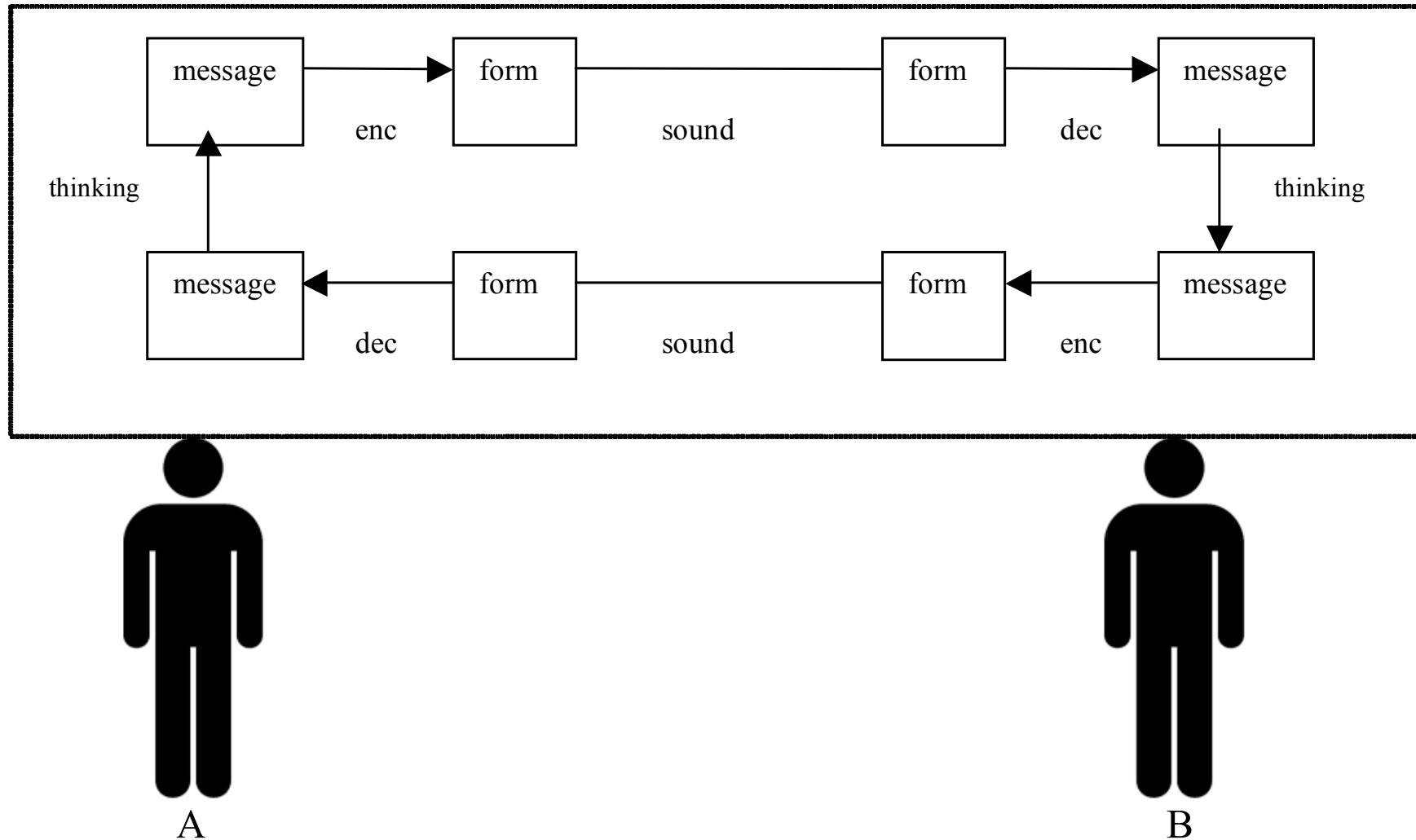Transcript of a multi-party dinner conversation (Tannen, 1984)

1---- **A:** I shook hands with Rubenstein once? [and his hand
2-----**B:**   [Yeah we did together
3-----**A:** That's right. we were together. wasn't it incredible?
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Interactive alignment as response to challenge
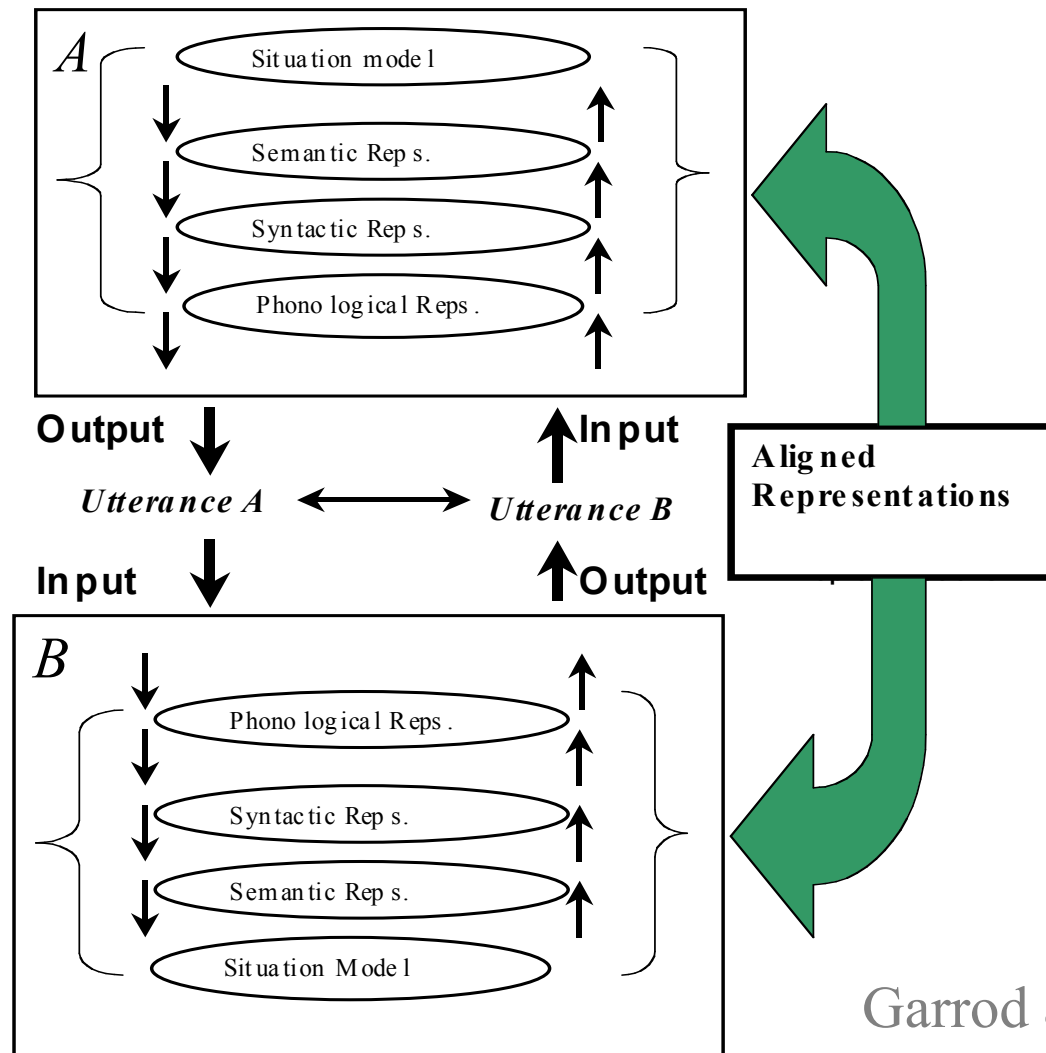
Garrod & Pickering, TICS (2004)

Dialogue in traditional model of communication

Vertical and Horizontal Splits

- Vertical - discrete processes in *A* & *B*
  - Linked only through the sound

- Horizontal - *Cognitive Sandwich (Hurley,2008)*
  - Perception - Thought - Action
  - Comprehension - Thought - Production

Dialogue challenges - vertical split

Joint productions

(1) Horton & Gerrig(2005)

A: and um it- you know it's rea- it's it was really good and of course
she teaches theology that was another thing
B: mm
A: I- m- I- Isabelle
B: oh that's great.

(2) Tannen(1989)
1---- **A:** I shook hands with Rubenstein once? [and his hand
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Challenges to horizontal split

- **Comprehension influences production**
  (picture-word interference, Schriefers et al 1990)
  - Hearing *dot* enhances describing picture of DOG

- **Production influences comprehension**
  - Manipulating cheeks (up or down) affects speech recognition(Ito et al, 2009)
  - Stretch cheeks up - hear *had* as *head*

Acts *vs* Processes

- *Acts*
  - Production of complete utterance
  - Comprehension of complete utterance

- *Processes*
  - *Prod:* Intention -> semantics -> syntax -> phonetics
  - *Comp:* Sound -> phonetics …. -> intended meaning

Acts interweave processes?

- Acts of production use processes of both production & comprehension
  - Primarily for efficient monitoring
- Acts of comprehension use processes of both comprehension & production
  - Primarily for emulation and prediction
- Greatly enhances dialogue processing

Lessons from action/perception research

- Motor control theory uses perceptual representations for action (Wolpert, 1997)
  - Forward *dynamic* and *output* models (*predicted action & predicted perceptual outcome*)

- Perception of action also uses action-based forward models

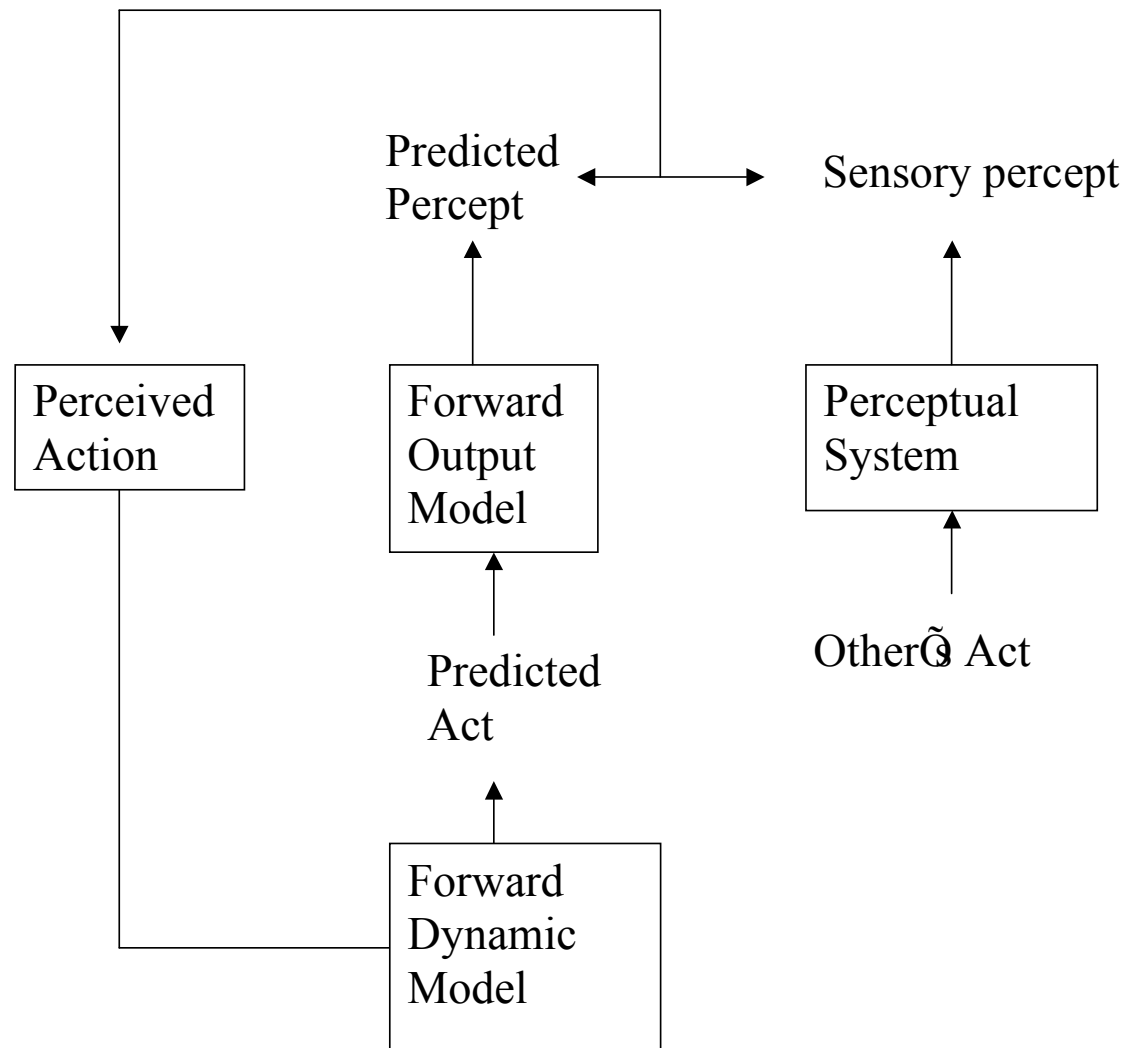# Forward modeling of action
(e.g.Wolpert,'97)
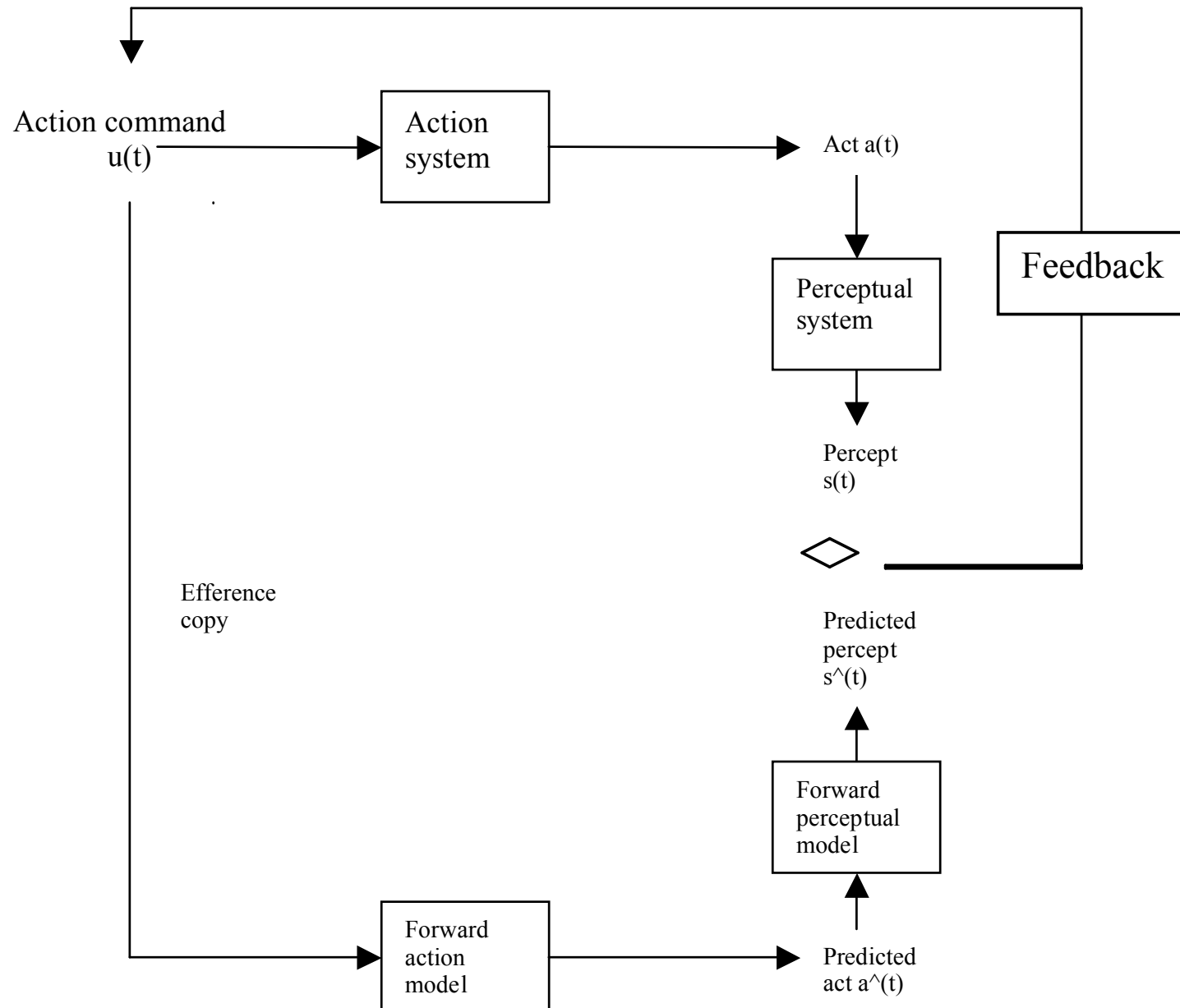
How action uses forward models

- To support state estimation - self monitoring
  - Best estimate of where you are combines predicted with observed position
- To cancel reafference - world monitoring
  - e.g., can't tickle yourself (Blakemore et al. '99)
- For motor learning and adaptation
  - Use forward model error to modify inverse model for better fit

Action/perception conclusions

- Efficient motor control uses *forward models* of actions to predict perceptual outcomes

- Efficient perception of others' actions uses *forward models* of inferred actions to help perceive and predict others' actions

Forward modeling of observed action
## (e.g. Wolpert et al 2005)

How action perception uses forward models

- To estimate other's intentions

    – HMOSAIC (wolpert et al. 2005)

- To predict other's action outcomes

- To support *joint actions*

    – Coordinated timing of actions

    – e.g. *ballroom dancing, jointly lifting a table*

Returning to language

- *Language Production* is a kind of action
- *Language Comprehension* is a kind of perception of another's action

- *Dialogue* is a joint action

Control theoretic model of production
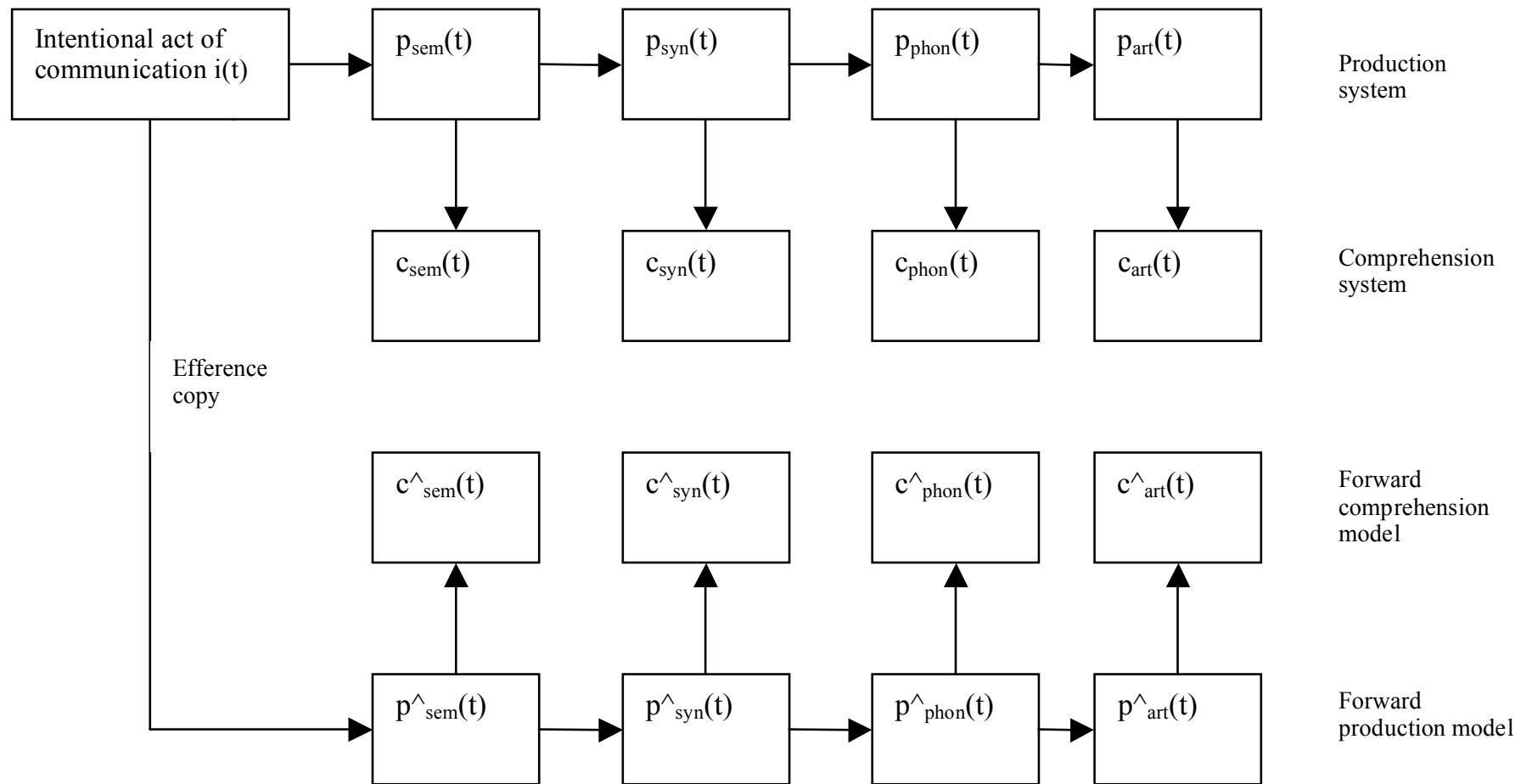
Production evidence

- Rate of self-monitoring (Hartsuiker et al. 2001)

- Reafference cancellation during speech
  - MEG M100 reduction for undistorted vs distorted speech feedback (Heinks-Maldonado et al. 2006)

- Rapid adaptation to distorted feedback
  - Speakers adapted to formant-pitch-shifted feedback within 100 ms. fMRI identified a network modulated by mismatch between expected and observed (Tourville et al.2008)

Control theoretic comprehension model

Pickering & Garrod TICS (2007)
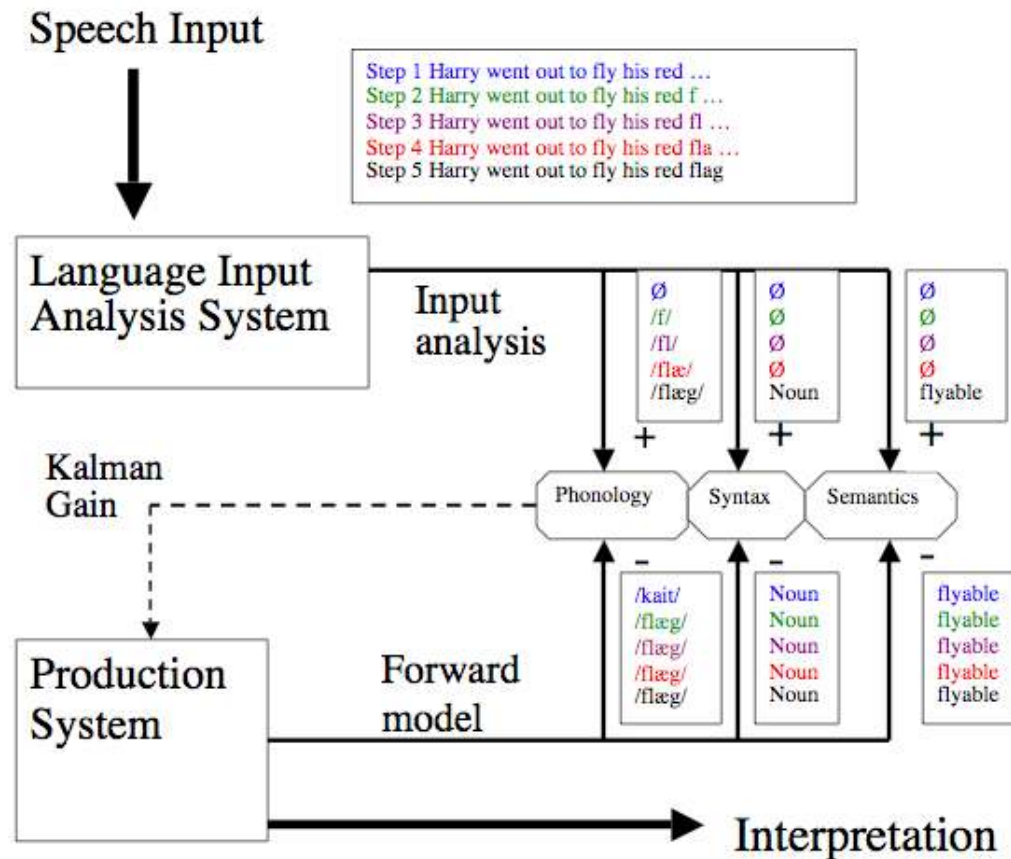
Comprehension evidence

- ## Motor involvement in speech perception
  - TMS to lip control areas improves discrimination of lip but not tongue related syllables vice versa for tongue control areas (D'Ausilio et al 2009) see also Möttönen et al 2009.

- ## Ghost reafference effects in speech perception
  - Manipulating cheek muscles affects speech perception (Ito et al 2010)

- ## Comprehension adaptation effects associated with production
  - Adaptation to compressed speech modulates left ventral premotor cortex (Adank & Devlin, 2010)

# Comprehension evidence (2)

- Evidence for pervasive prediction during language comprehension
  - Visual world (Altmann & Kamide etc.)
  - EEG
    - Van Berkum et al. (2005)
    - De Long et al.

Van Berkum et al. (2005)

The burglar had no trouble whatsoever to locate the secret family safe. Of course, it was situated behind a...

——— consistent with discourse-predictable noun

- - - - - inconsistent with discourse-predictable noun
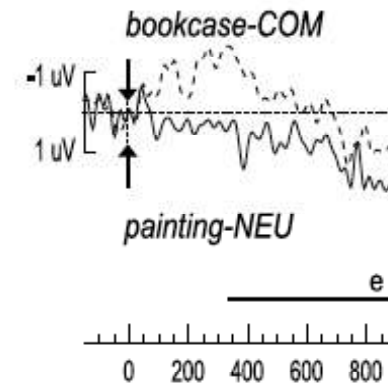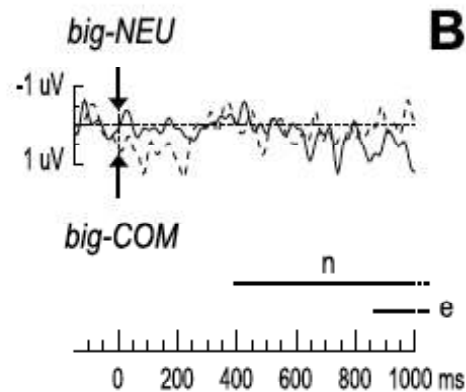
DeLong et al. (2005)

- Increased N400 for *an* over *a* in context that predicts *bike*

    - *Harry was learning to ride a/an …*

Why dialogue?

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Summary & Conclusions

- Dialogue challenges traditional accounts that separate production & comprehension

- Action-perception research interweaves perception & action

- Increasing evidence for interweaving of production & comprehension processes

- Points to a control theoretic account of dialogue processing

~ The End ~

Thank you