



**Donders Institute**  
for Brain, Cognition and Behaviour

# **A closer look at pronoun comprehension**

## **Comparing different methods**

**Christina Bergmann**  
**Markus Paulus**  
**Paula Fikkert**

**Radboud University Nijmegen**





## Asymmetric Pronoun Acquisition

Delay in correct **comprehension of pronouns** in comparison to reflexives and in comparison to correct production (see Chien & Wexler, 1990; and a vast amount of subsequent studies in English, Dutch, German, etc.)



## Asymmetric Pronoun Acquisition



	Reflexives
Production	Adult-like
Comprehension	Adult-like



## Asymmetric Pronoun Acquisition



	Reflexives	Pronouns
Production	Adult-like	Adult-like
Comprehension	Adult-like	<b>Chance level</b>





## Asymmetric Pronoun Acquisition



	Reflexives	Pronouns
Production	Adult-like	Adult-like
Comprehension	Adult-like	<b>Chance level</b>



## Methods to Investigate Comprehension

### Act-Out:

Make the cat touch her/herself.

### Truth Value Judgement Task:

The bear touches him/himself.

Did Kermit get it right?

### Picture Selection Task:

Choose the picture where the frog is touching him/himself.





## Methods to Investigate Comprehension

Common factors of behavioural methods

Response-based

Secondary task

Attention to both the linguistic input and the appropriate response

Planning and executing the respective action

Results possibly influenced by children's **limits in attention span** and **memory capacity** (as previously suggested by Bloom et al, 1994)





## Eye Tracking

### Implicit measurement

No secondary task, hence no additional demands on memory and attention

### Visually presenting several objects and naming one

Time-locked increase in number of fixations and longer fixation time  
(Tanenhaus et al, 1995)

### Allows for various dimensions of analysis

Short, time-locked events

Change of fixation behaviour over time

Fixation dynamics







## Experimental Approach

Compare automatic (**eye tracking**) and behavioural responses  
(**picture selection task**)

Measuring linguistic competence should yield **similar results**  
*independent of the method*





## Experimental Approach

Two general conditions

Object pronouns vs reflexives

(In line of Chien & Wexler, 1990, Experiment 4)

*Mama bear is touching her/herself.*

Participants

Age group 4: 16 children between 3;08 and 3;11 (mean: 3;10;04)

Age group 3: 22 children between 2;11 and 3;01 (mean: 3;0;21)





## Part 1: Eye Tracking

12 Pronoun trials

*Meneer Beer is hem aan het wassen.*

*(Mister Bear is him washing.)*

12 Reflexive trials

*Meneer Beer is zich aan het wassen.*

*(Mister Bear is himself washing.)*

24 Baseline trials

*Kijk, dat is lief!*

*(Look, this is nice!)*

Baseline:

Account for visual saliency

Measure fixation behaviour without explicit reference to scene



## Part 2: Picture Selection Task

Identical pictures and sentences as used in the eye tracking task,  
no distractor or baseline



*Mevrouw koe is haar aan het uitkleden.*

*Op welk plaatje is mevrouw koe haar aan het uitkleden?*

*(Miss cow is her undressing.*

*In which picture is miss cow her undressing?)*



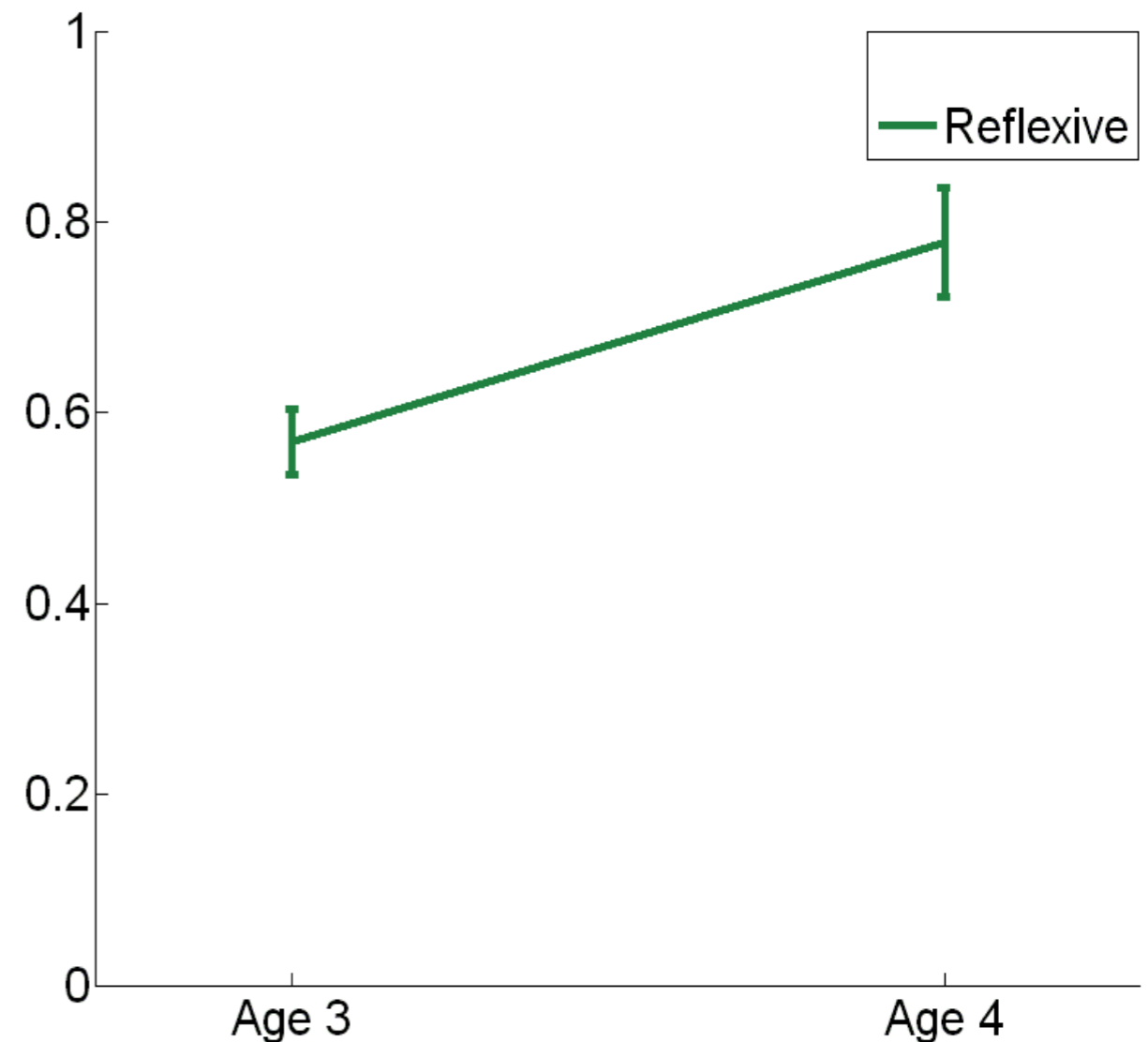


## Results: Picture Selection Task

Across age groups:

Improvement in the reflexive condition

From chance level to 79% correct

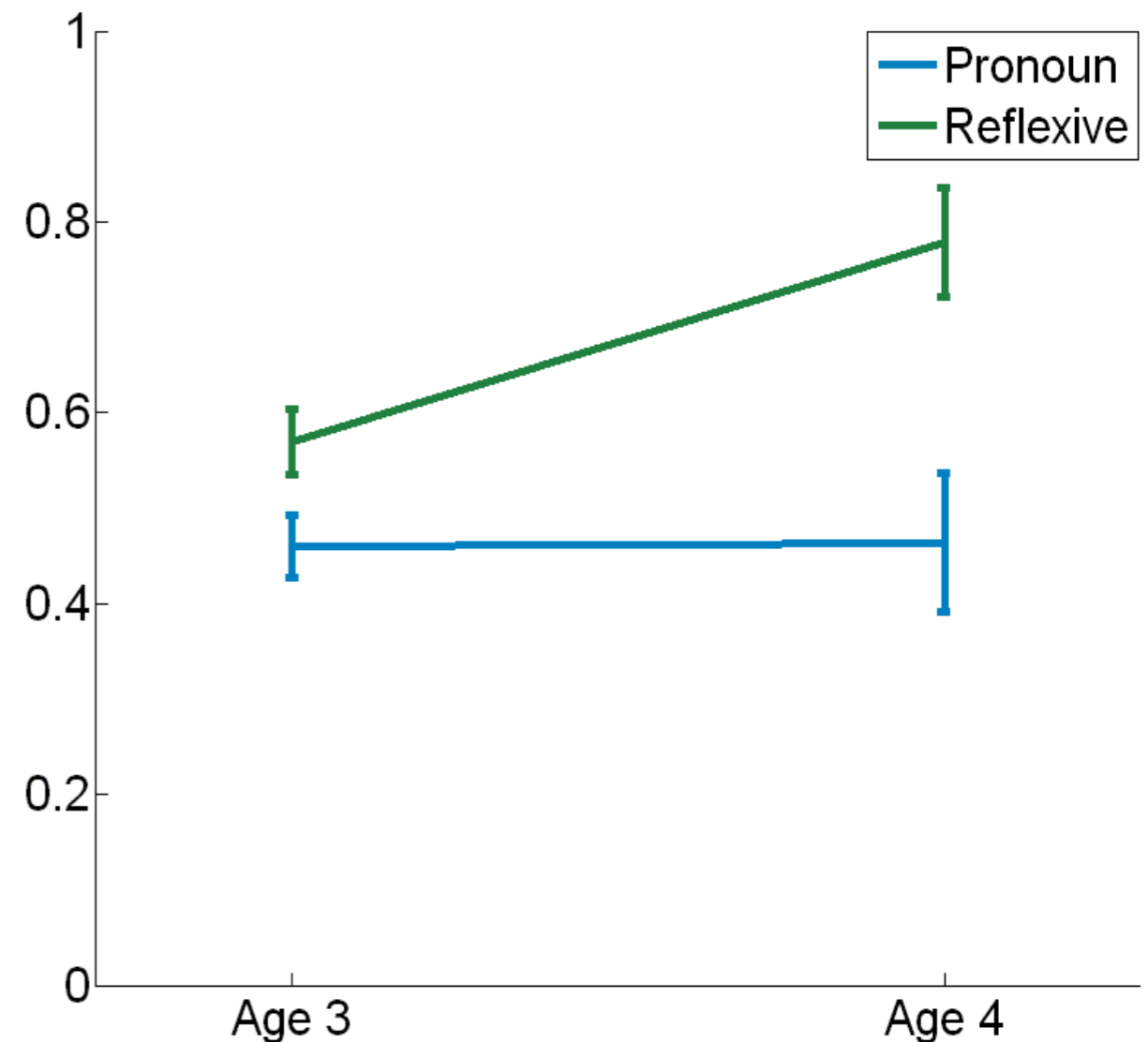




## Results: Picture Selection Task

No change in the pronoun condition

Both age groups at chance level





## Results: Picture Selection Task

3 year olds:

Performance on chance level in both conditions

4 year olds:

Effect of condition:  $p < 0.01$

Strategy: pick the picture on the left (32%)

Strategy: always choose reflexive (18%)



## Results: Eye Tracking



**Agent:** Directly named subject of the sentence, actor

**Patient:** Correct referent in the pronoun condition

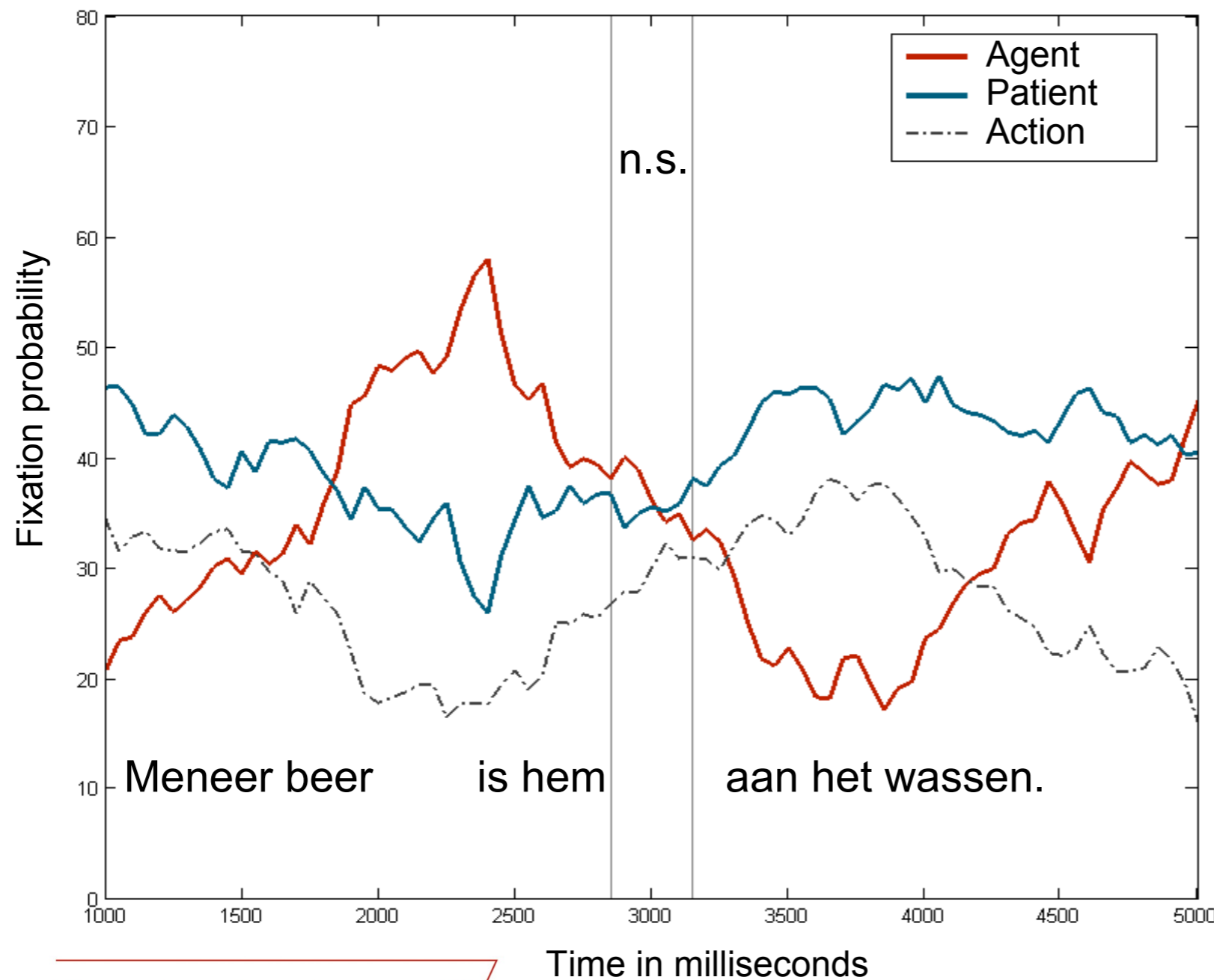
**Action:** Region around the action

Separate analysis of the most salient change across pictures





## Results: Eye Tracking – Age 3



Pronoun condition

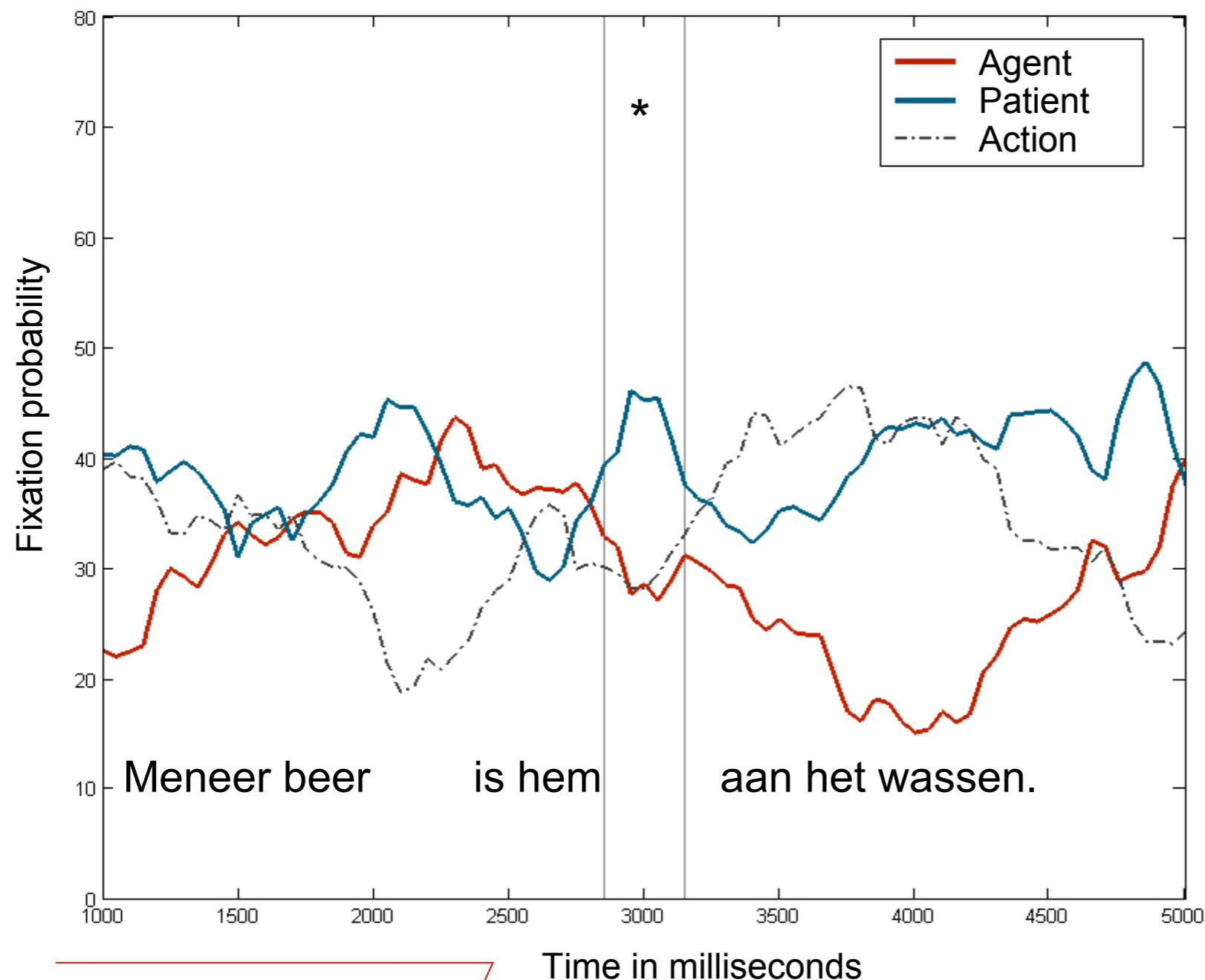
Time slot:  
300-600 ms after  
onset of the pronoun

Baseline trials:  
Agent and patient at  
33%





## Results: Eye Tracking – Age 4



Pronoun condition

Maximum fixations on the patient: 46% at 2950 ms

Fixations on the agent at 2950 ms: 27%

Baseline trials: Agent and patient at 30%

$p < 0.05$





## Discussion

Picture selection task replicates previous results and shows a developmental improvement for **reflexives only**

Pronoun comprehension results do **not** change

Eye tracking strongly suggests a **correct, automatic** interpretation of pronouns in 4 year olds

This is not yet the case in the younger age group





## Conclusion

Eye tracking data shows **comprehension earlier** than the picture selection task and other behavioural methods

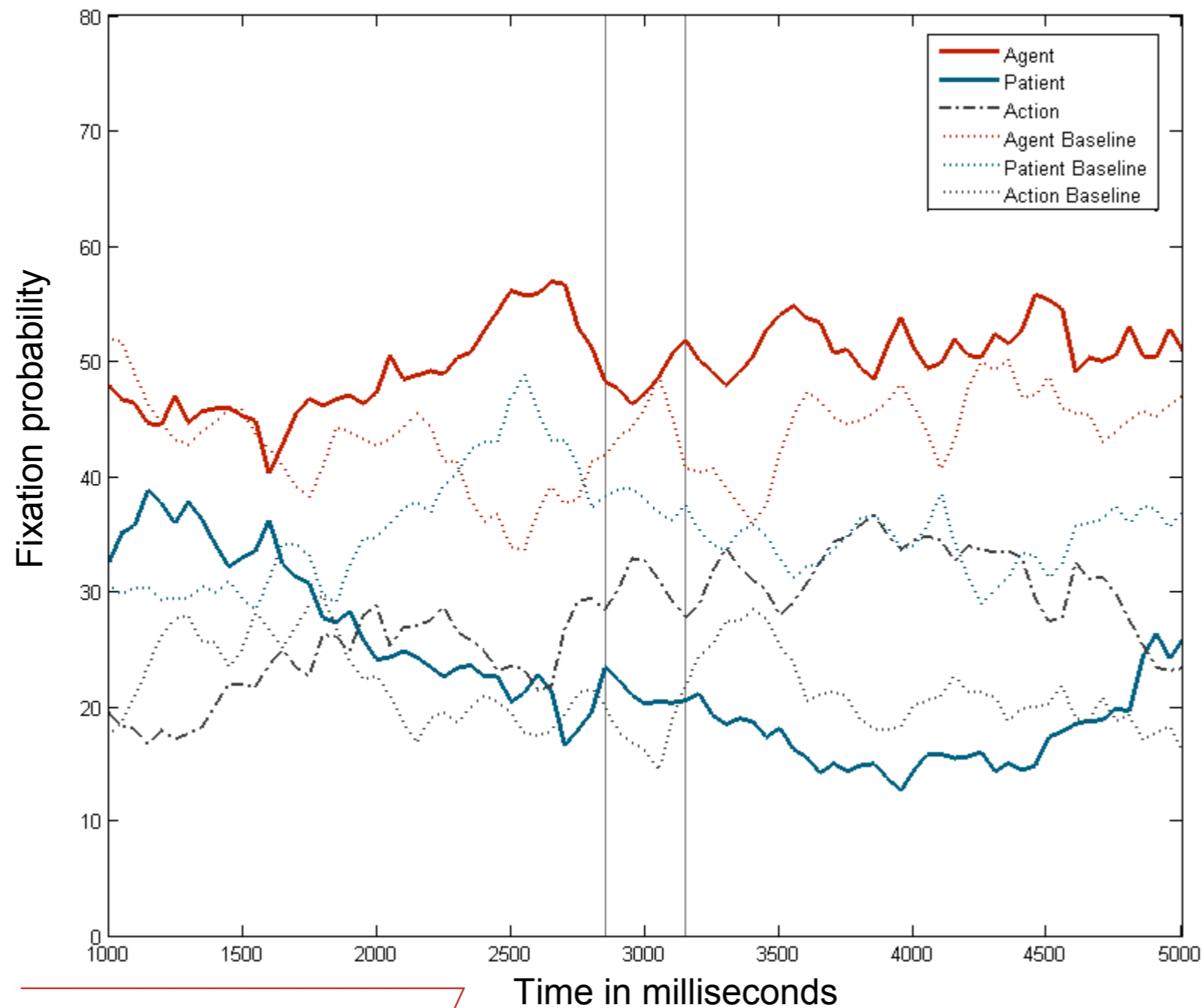
Behavioural methods sensitive to **extralinguistic factors**





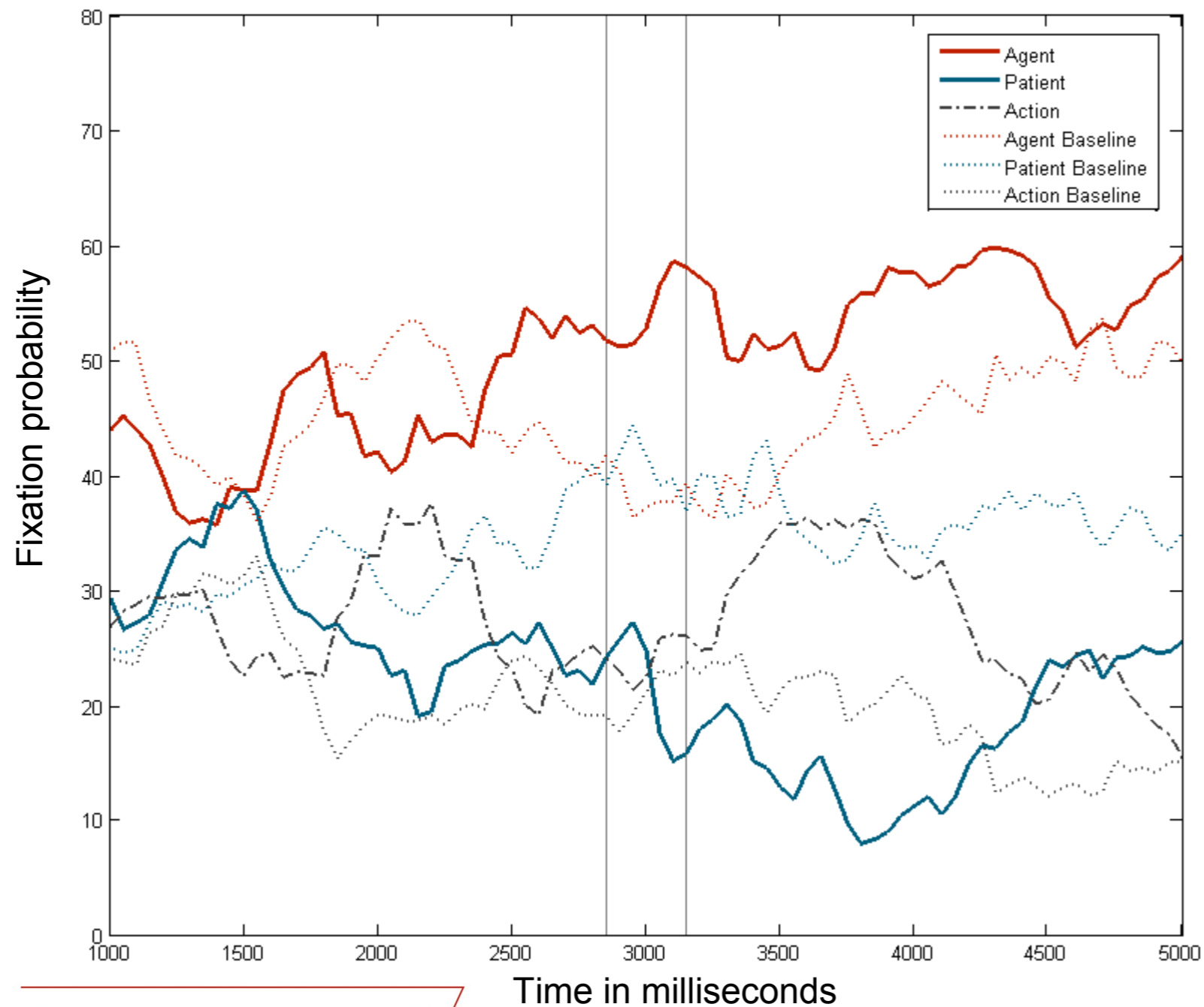


## Additional Slide: Eye Tracking – Reflexive Condition: Age 3



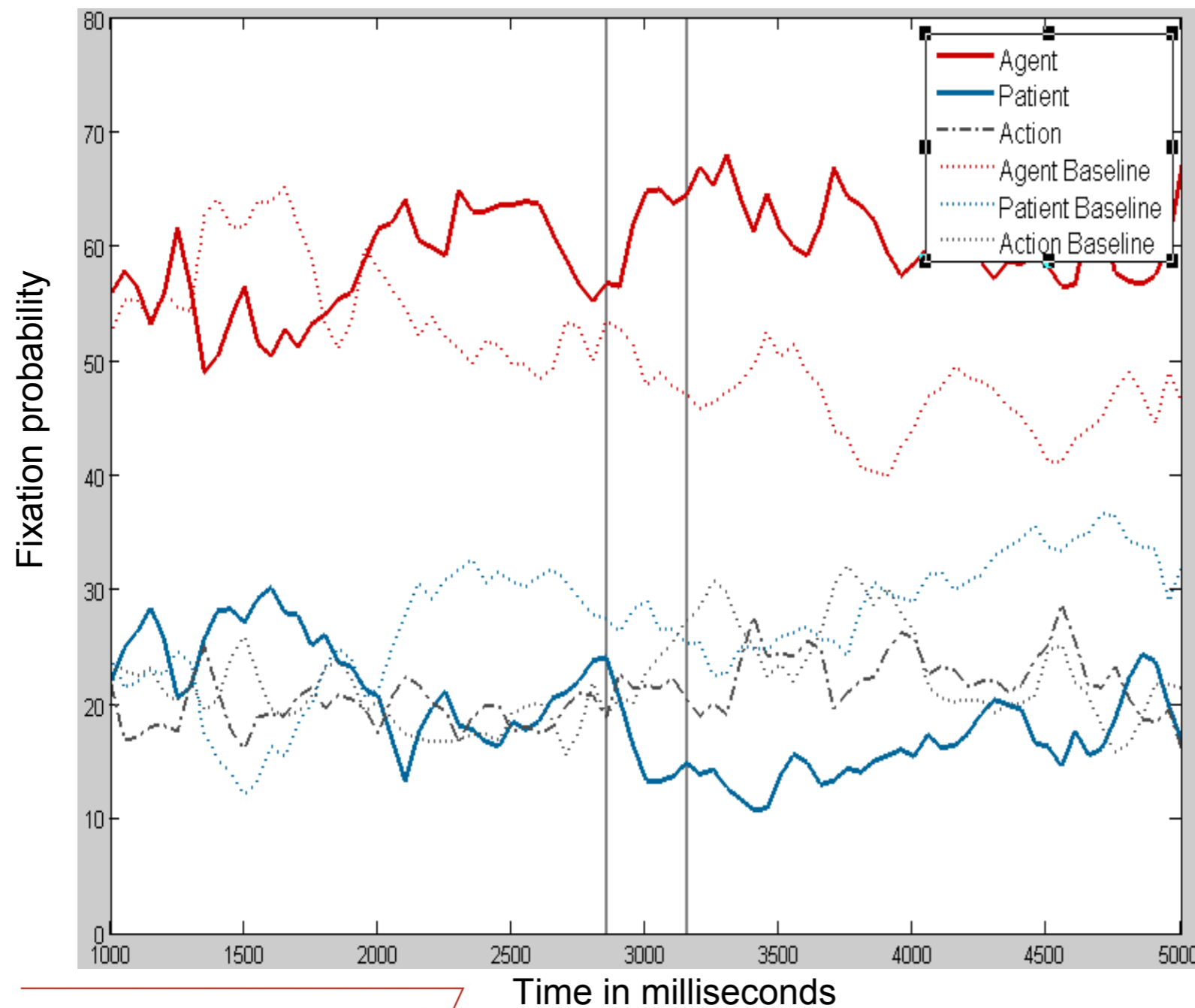


## Additional Slide: Eye Tracking – Reflexive Condition: Age 4





## Additional Slide: Eye Tracking – Reflexive Condition: Adults





## Additional Slide: Eye Tracking – Pronoun Condition: Adults

