What do you know? ERP evidence for immediate use of common ground during online reference resolution

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Introduction

Perspective-Taking

- Virtually all communicative exchanges have asymmetry between what participants know
- Perspective is critical for creating and interpreting referring expressions
- Interlocutors must distinguish between **privileged ground (PG)**, knowledge possessed by one, and **common ground (CG)**, knowledge possessed by both and mutually accepted as such [1,2]

Research Question: How do we track perspective?

Anchoring & Adjustment ("curse of knowledge") [3]

- Accessing and using CG is cognitively costly
- First-pass interpretation typically does not attempt to consider CG
- Second-pass can use CG to detect and correct errors
- Unusual circumstances can override this default egocentric perspective

Anticipation & Integration [4-6]

- Individuals can strategically anticipate items in CG
- But they automatically consider all referents in their egocentric perspective as referential description unfolds

Constraint-Based [7-9]

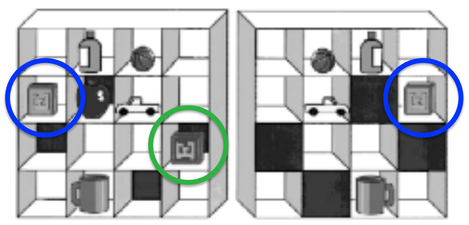
- Humans are natural perspective takers
- Accessing and using CG is relatively easy
- However, CG is one of many competing cues

Previous Work

Keysar and colleagues [10-12]

Task: Referential communication game

"Pick up the block"



Addressee's view Director's view

Results: PG competitor elicited increased fixations and delayed the selection of the target

Open Questions

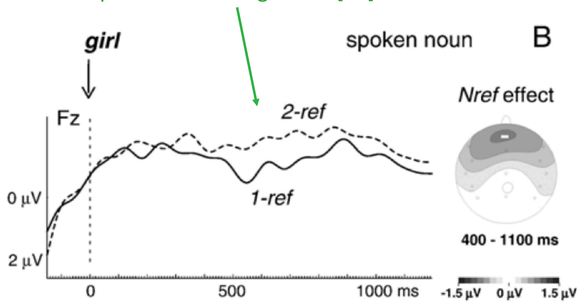
Why do participants fixate the PG competitor and why are they delayed in picking up the target?

1. Truly consider competitor to be a candidate for reference
2. Low-level attention is drawn to competitor due to relatedness (i.e., a behavioral distraction effect)

Behavioral measures cannot distinguish these possibilities. Can ERP methods help?

Nref Effect – Sensitive to referential ambiguity [13-15]

Effect can persist 1 sec or more after point of disambiguation [15]



2-ref : *David had asked the two girls to clean up their room before lunchtime. But one of the girls had stayed in bed all morning, and the other had been on the phone all the time. David told the...*

1-ref : *David had asked the boy and the girl to clean up their room before lunchtime. But the boy had stayed in bed all morning, and the girl had been on the phone all the time. David told the...*

Materials · Methods · Predictions

Conditions	Trials
CG Competitor	40
PG Competitor	40
No Competitor	40
Control 1 (C1)	40
Control 2 (C2)	40
	200 total

Participants

- 50 right-handed, native speakers of American English (26 male)
- Mean age: 19.0 (range 18 to 22)

EEG Recording

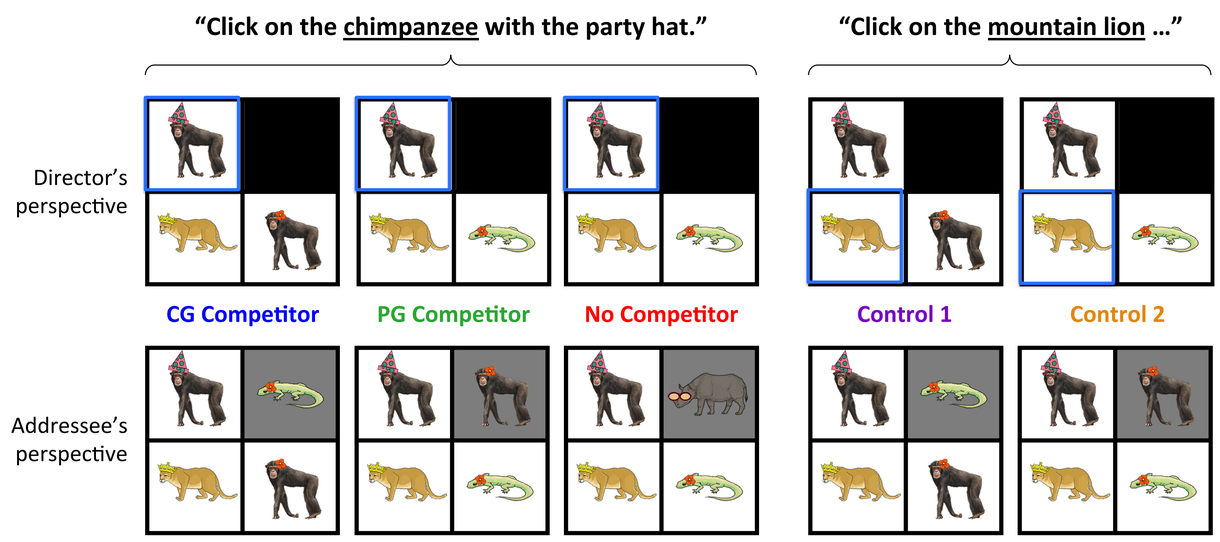
- 64-channel HydroCel GSN (EGI)
- Bandpass: 0.03-40 Hz
- Re-reference: Avg. mastoids
- Voltages averaged for analysis within nine 4-channel clusters

Task

- Modified referential communication game
- Press key corresponding to quadrant

Familiarization

- 20 trials as Addressee
- 20 trials as Director
- "Can you describe to me what the Director can see during the game?"



Experimental session

- Animals appear one by one (1000 ms SOA)
- Fixation prompt: Bell rings and red fixation cross appears in center of display (600-900 ms)
- Pre-recorded auditory stimulus (ms)

Target onset	M = 2882 (200)
Disambiguation	M = 879 (112)
Total duration	M = 4862 (438)

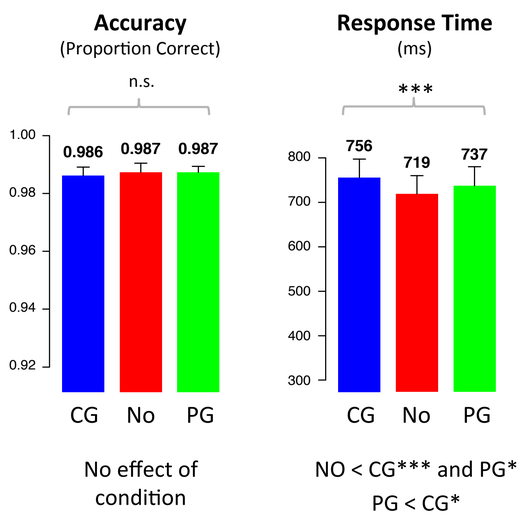
- Response prompt: Bell

Predictions

1. Referent with CG competitor should elicit Nref effect relative to no competitor
2. If so:
   a. If PG competitor considered candidate for reference
      → Nref effect
   a. If PG competitor not considered as candidate
      → No Nref effect

Results and Discussion

Behavioral Results



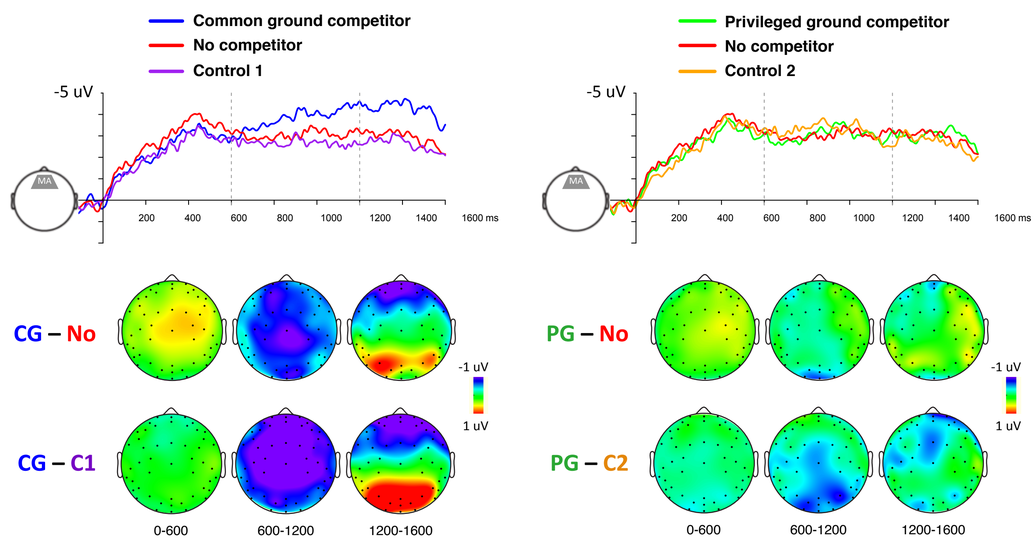
No effect of condition

NO < CG*** and PG*
PG < CG*

→ Replicates effect of PG distraction seen in earlier studies

All statistical effects remain even when looking at first half only.
Effects are numerically similar when looking at first quarter only.

ERP Results



→ CG competitor condition elicits Nref effect

By 600 ms after auditory word onset, system has determined whether unique referent or not

→ PG competitor condition does not elicit Nref effect

Suggests PG object not considered to be a candidate for reference

References

1. Stalnacker 1978
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5. Barr 2011
6. Barr, in press
7. Hanna, Tanenhaus & Trueswell 2003
8. Brown-Schmidt & Hanna 2011
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10. Wu & Keysar 2007
11. Keysar, Barr, Balin & Brauner 2000
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15. Nieuwland, Otten & Van Berkum 2007
16. Baron-Cohen, Wheelwright, Skinner, Martin & Clubley 2001

Conclusions

- The present work replicates the behavioral distraction effect of a competitor in privileged ground, but without the neural signature corresponding to referential ambiguity
  → This indicates that behavioral distraction does not always reflect referential processing
- ERP results show that listeners efficiently used ground to constrain potential referents to objects in common ground
  → Extends previous results that ground information influences on-line language processing without being triggered by unusual circumstances [9]
  → Argues against both Anchoring & Adjustment and Anticipation & Integration accounts

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Current Ongoing Research

Les Sikos, Harm Brouwer, Heiner Drenhaus, and Matthew W. Crocker (Saarland University)

Research Question

Is brain response to referential ambiguity greater when more potential referents are available in situation model? **3-ref > 2-ref ?**

Previous Work

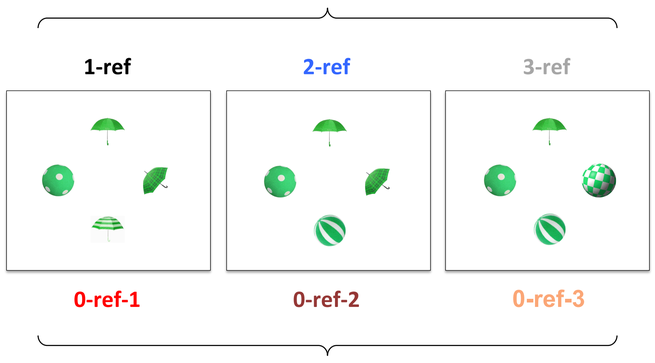
Greater ambiguity elicits larger Nref effect (Nieuwland & van Berkum, 2006)

Implications

Results of this study could help inform our understanding of referential processing and server to constrain future computational models of such processing

Experiment 1 – Visual World

"Is the ball that is dotted on the left?" (True)



"Is the umbrella that is striped on the left?" (False)

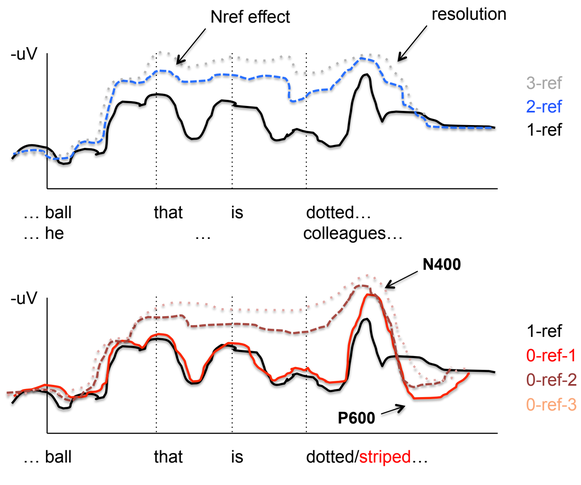
Experiment 2 — Linguistic

1-ref
Three movie stars, **Brad Pitt, Julia Roberts, and Catherine Zeta-Jones**, went to the premier of a new film. Although he was already sitting in the theater, Brad Pitt's colleagues were still on the red carpet.

2-ref
Three movie stars, **Brad Pitt, George Clooney, and Catherine Zeta-Jones**, went to the premier of a new film. Although he was already sitting in the theater, Brad Pitt's colleagues were still on the red carpet.

3-ref
Three movie stars, **Brad Pitt, George Clooney, and Matt Damon**, went to the premier of a new film. Although he was already sitting in the theater, Brad Pitt's colleagues were still on the red carpet.

Predictions



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