Speech planning in question-response interactions from a clinical perspective
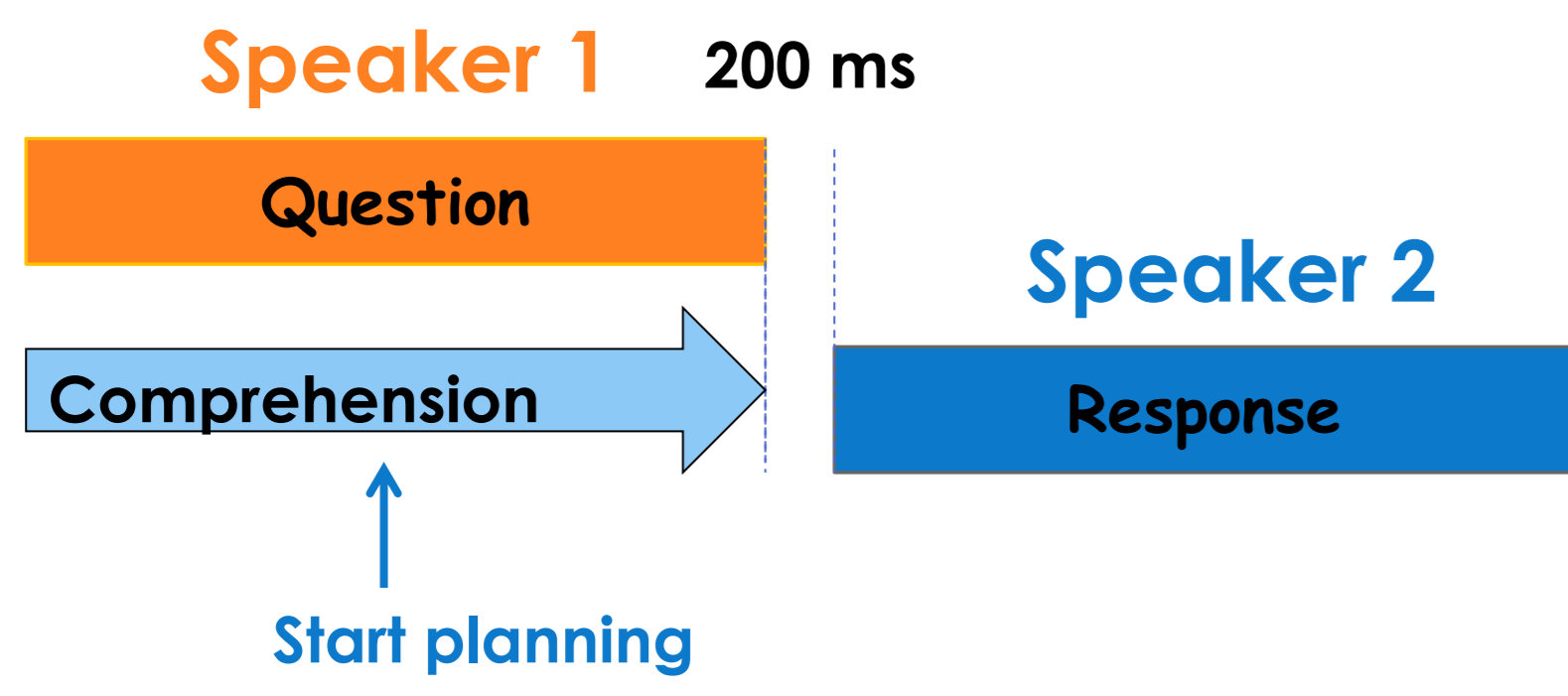
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Introduction

1. Speech planning in interaction

- Overlap between question comprehension and response planning [1, 2]
- Comprehension and planning strategies vary across individuals, depending on their cognitive abilities (e.g., speed of processing, [3, 4, 5])

2. Multiple Sclerosis (MS)

- Demyelinating lesions in the brain and spinal cord
- Cognitive impairment up to 65% patients with MS: deficits in planning and decision making, working memory, attention and speed of processing [6]

Research questions

- Do cognitive impairment affect planning in interaction?
- Which is the role of early prosodic information in question comprehension and response planning?

Procedure

- Question-response game: Participants orally replied to 24 trials consisting of a sequence of two pre-recorded questions (Q1 and Q2).
- Monitoring eye movements to lexical competitors during Q2 comprehension + latencies of speech responses [7]

Questions:

- 24 pairs of imageable nouns with similar phonetic onset, matched for lexical frequency (= 33.5) and number of syllables (=2)
- Standardized pictures [3]
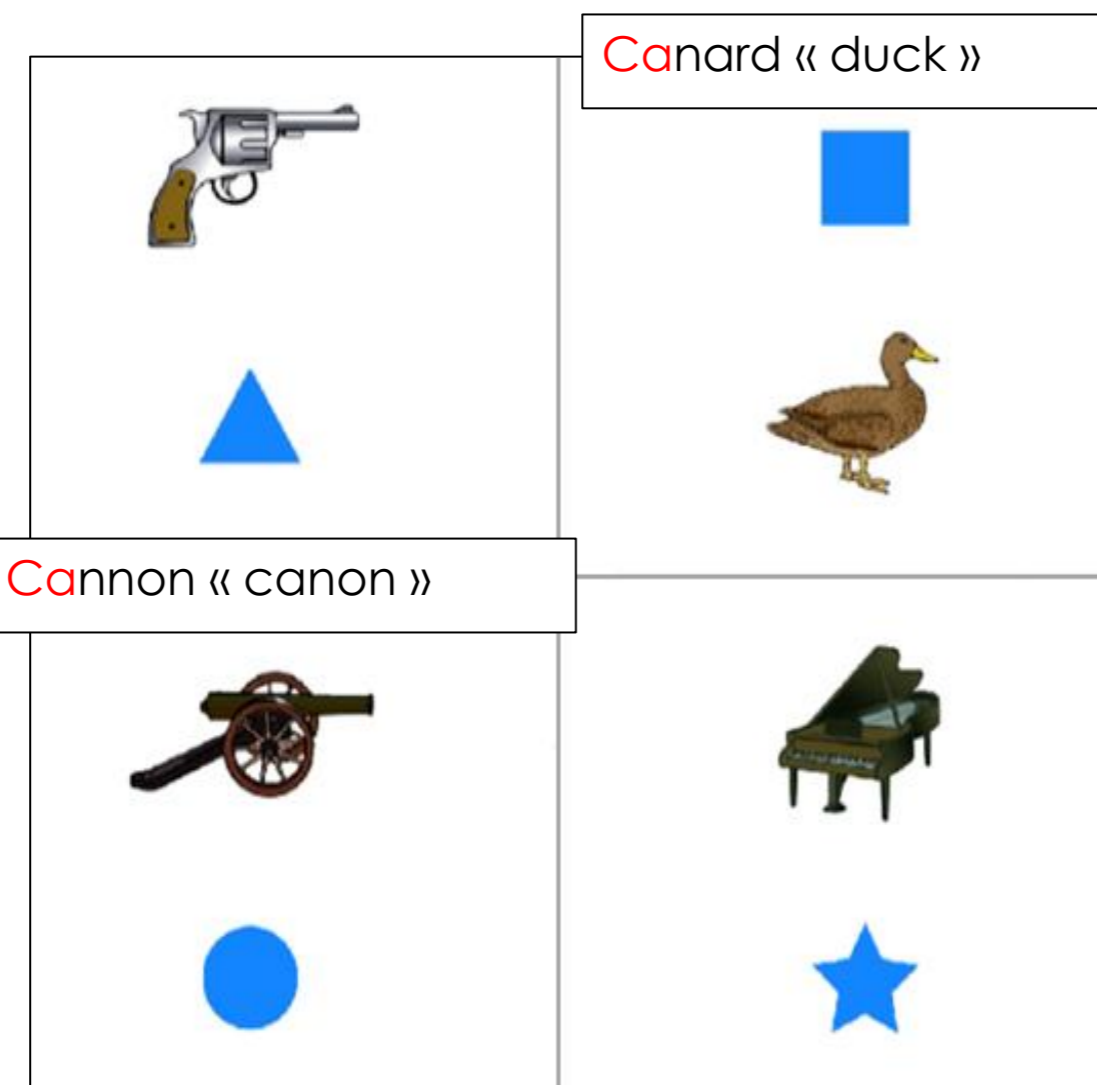
Q1: Est-ce que le canon/canard est au dessus de l'étoile?
Q2: Et est-ce que le canard est en dessous du rond?
(« is the duck above the star? And is the cannon/duck below the circle? »)

	Accented	Deaccented
Anaphoric	canard ->CAnard **(incongruent)**	canard -> canard **(congruent)**
Non-anaphoric	canon -> CAnard **(congruent)**	canon -> canard **(incongruent)**

Response to Q2:
Non   le canard est en dessous du carré

gap   pause
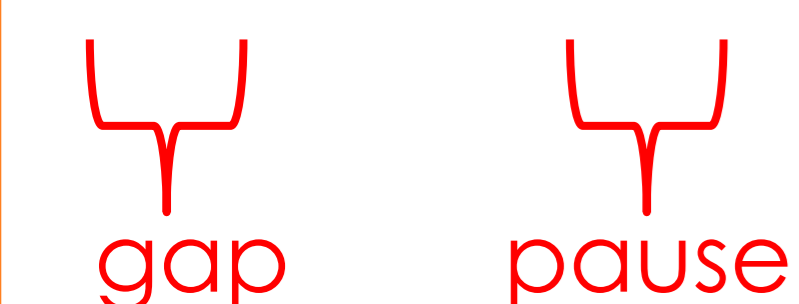
(« No, the duck is below the square »)

Statistics:
- Cluster-based permutation analysis
- Linear mixed models

Hypotheses

1a. If prosody is used for reference resolution [7], accentuation on the ambiguous syllable should facilitate a non-anaphoric interpretation

1b. If accentuation is not reliable in French to infer the contrastive status of a word [8], listeners should use more segmental information

2. Given that planning a response is cognitively more demanding than understanding a question, differences between MS and HC will emerge more strongly on speech latencies

Materials

Q2: « And is the duck above the circle? »

Accented / Deaccented
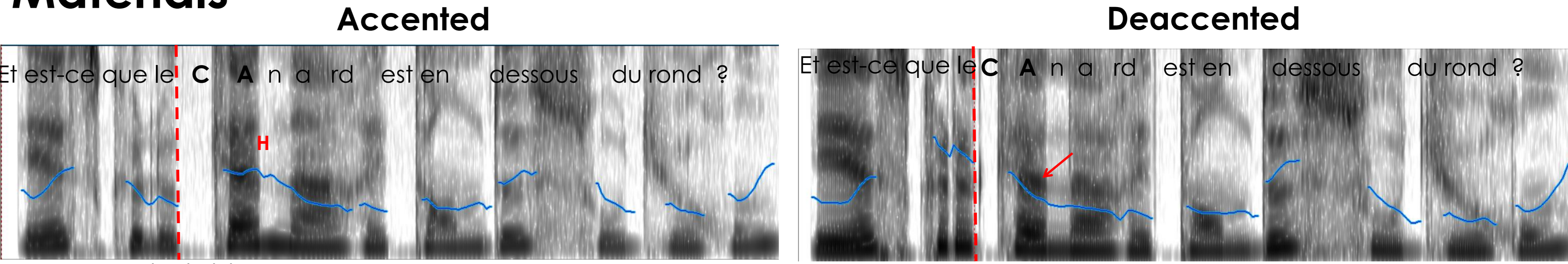
- Emphatic initial accent [9]

Participants

Demographics	HC n = 35	MS n = 35
Age	34.1 (9.3)	34.6 (8.7)
Gender	29 F + 6 M	29 F + 6 M
Desease Duration		4.94 (3.5)
EDSS		1.38 (0.99)

Neuropsychological tests	HC	MS	p	
PASAT	46 (9.2)	41 (11.6)	**0.048**	Speed of processing
SDMT	55.2 (5.7)	52.4 (8.9)	**0.003**	Speed of processing
S-fluency	32.1 (6.7)	35.6 (7.4)	**0.043**	Verbal fluency
P-Fluency	22.8 (7.1)	26.7 (5.09)	**0.011**	Verbal fluency
LN-Seq	6.6 (1.3)	6.1 (1.1)	0.059	Working memory

- 35 patients of early stages of relapsing-remitting Multiple Sclerosis (MS) + 35 Healthy Controls (HC)
- **Inclusion criteria** : no relapses at the time of the study; no optic nevritis; optimal vision; no articulation troubles [10]
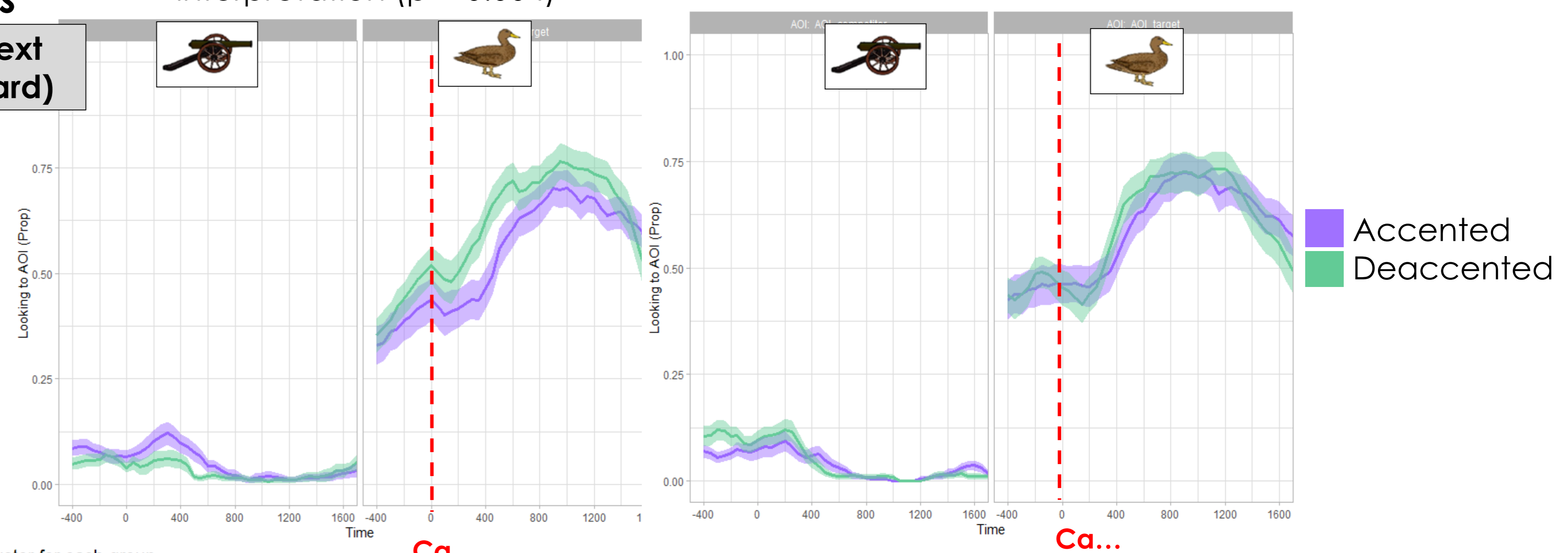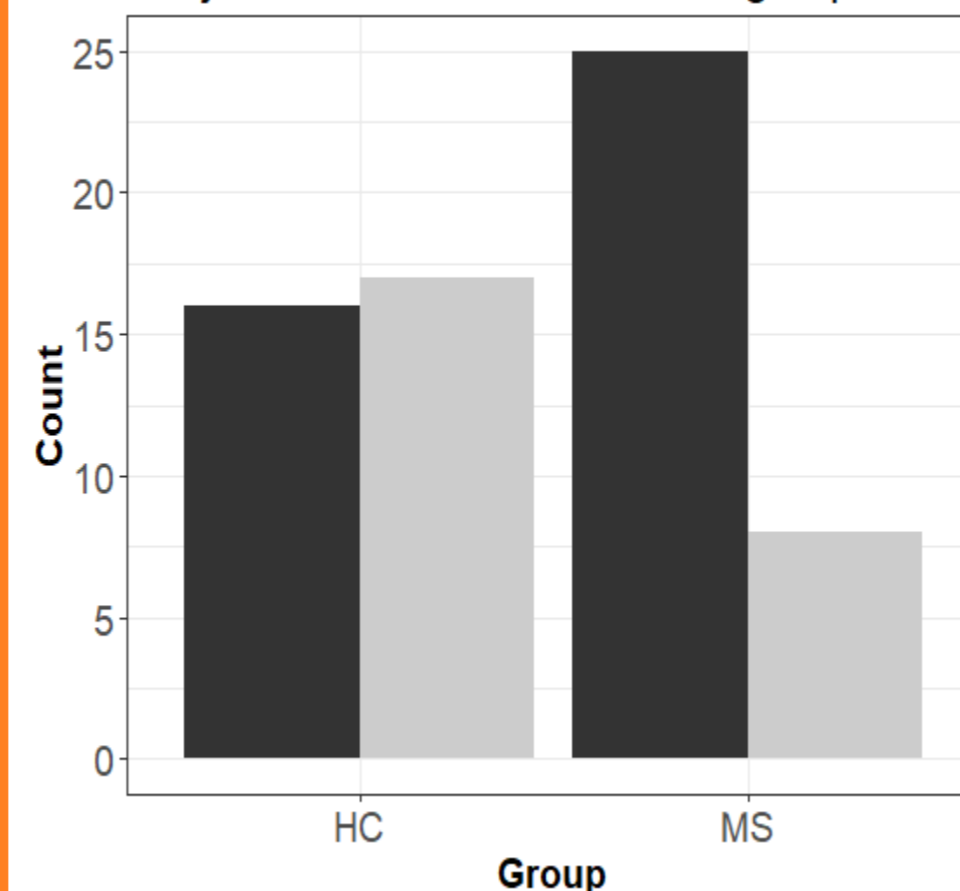
Results

Fixation Proportions

Anaphoric context (canard -> canard)

MS
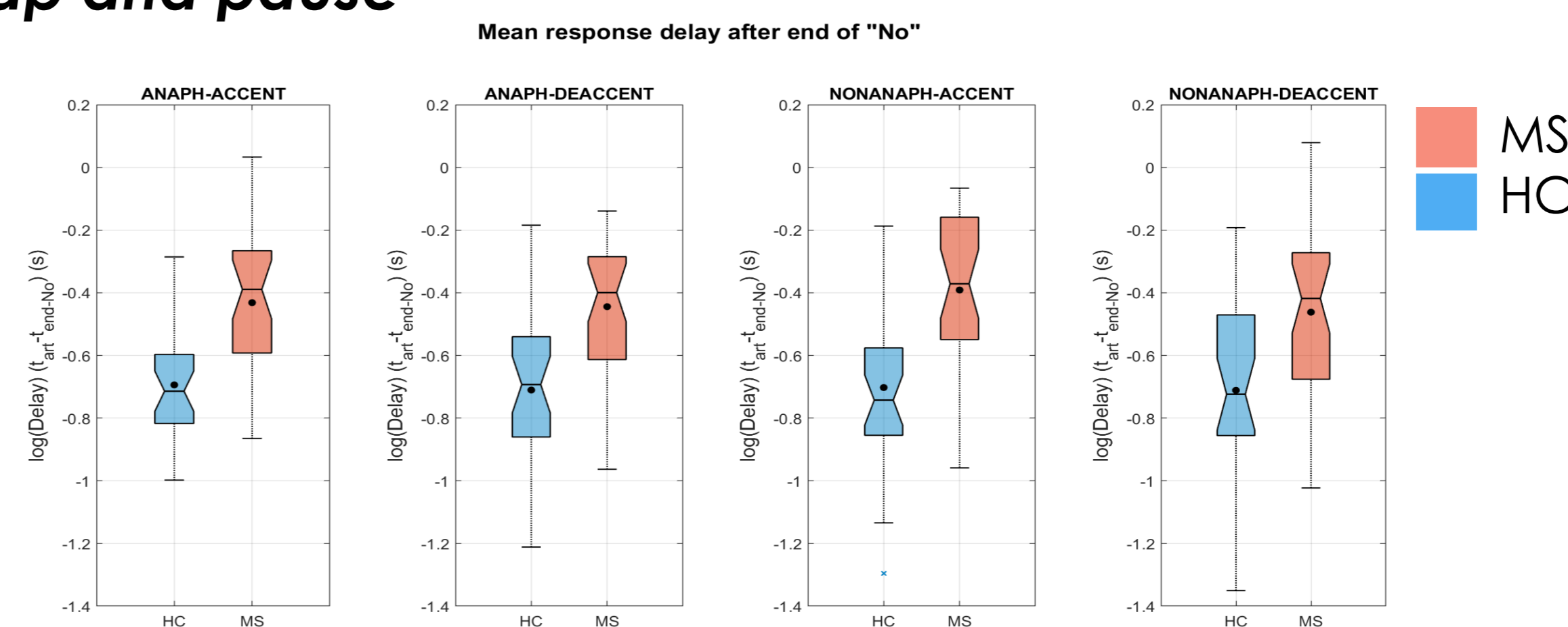Accent leads to non-anaphoric interpretation (p = 0.004)

HC
No effects of accentuation

Accented / Deaccented

Subject count in cluster for each group
PROSODY+ / PROSODY-

- For both MS and HC: PROSODY- subgroup relies on segmental information; PROSODY+ subgroup relies on both prosody and segments
- MS group relies more on prosody than HC group
- For HC only, lower speed of processing scores for the PROSODY+ subgroups (PASAT : t=3.8, p <0.001)

Gap and pause

Mean response delay after end of "No"

ANAPH-ACCENT / ANAPH-DEACCENT / NONANAPH-ACCENT / NONANAPH-DEACCENT

MS / HC

No differences in gaps but longer pauses for MS (456 ms) than for HC (273 ms) (t=-5.11, p<.01)

Discussion

Question comprehension …

- MS patients are more sensitive than HC to coherence between accentuation and discourse status: Rapid integration of early prosodic information
- HC are fast (as reflected in the sharp rise of fixation proportions) even if they disregard prosody
- Subtle differences when looking at patterns of performance according to the use of prosodic and segmental information
- The use of the accent might be strategic: individuals with more limited processing of resources (as in the PROSODY+ subgroup for HC, or in the MS group) might need multiple sources of information for reference resolution [2, 4]

Response planning…

- No differences in gap duration
- Pause duration *after* "Non" much longer in MS than in HC: within-turn pause used to plan the full response as a strategy to preserve turn-taking
  -> correlations with cognitive scores?

References. [1] Bögels, S., Magyari, L., & Levinson, S. C. (2015). Neural signatures of response planning occur midway through an incoming question in conversation. *Sci.Rep.*, 5: 12881. **[2]** Bögels, S., Casillas, M. & Levinson, S.C. (2018). Planning versus comprehension in turn-taking: Fast responders show reduced anticipatory processing of the question. *Neuropsychologia*, 295-310. **[3]** Swets, B., Fuchs, S., Krivokapić, J. & Petrone, C. (subm.). A cross-linguistic study of individual differences in speech planning. **[4]** Rivière, E., Klein, M., Champagne-Lavau, M. (2018). Using context and prosody in irony under-standing: Variability amongst individuals. *J. Pragmat.*,165-172 **[5]** Esteve-Gibert, N., Schafer, A.J., Hemforth, B. *et al.* (2020). Empathy influences how listeners interpret intonation and meaning when words are ambiguous *Mem Cogn* **48**, 566–580 **[6]** De Looze, C., Moreau, N.,... & Petrone, C. (2017). Effects of cognitive impairment on prosodic parameters of speech production planning in multiple sclerosis. *J. Neuropsychol.* **[7]** Dahan, D., Tanenhaus, M. K., & Chambers, C. G. (2002). Accent and reference resolution in spoken-language comprehension. *J. Mem. Lang.*, 47(2), 292-314. **[8]** Swerts, M., & Vroomen, J.(2015). Accentshifts in spoken noun phrases affect verification latencies of listeners in Dutch but not Canadian French. *J. Phon.*, 52, 170-182. **[9]** Jun S.-A. & Fougeron C. (2000). A Phonological model of French intonation. In A. Botinis (ed.) *Intonation: Analysis, Modeling and Technology*. Dordrecht : Kluwer AP. 209-24. **[10]** Auzou, P., Rolland-Monnoury, V. (2006). Batterie d'évaluation de la dysarthrie, 1st ed. Isbergues: Ortho Edition.