



Modality switches occur early and extend late in conceptual processing: evidence from ERPs



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Engagement of sensory, motor brain regions during word recognition is well documented. Critical questions:

Functional role OR epiphenomenal processes? Directly compatible with **distributional** processing?

RESEARCH: Reaction time (**Conceptual Modality Switch/CMS** [1]), fMRI (seeing, reading colour in same cortex [2]), ERPs (**CMS** [3, 4]), causality-oriented TMS (hand action understanding in premotor cortex [5]).

CHALLENGE: Throughout the one second of word processing, multiple levels may gradually overlap [6]:



GOALS: Constrain time course of an effect, test distributional and embodied processing via CMS paradigm.

Task: verify the relation of property and concept words. **Covert:** conceptual modality of successive trials.

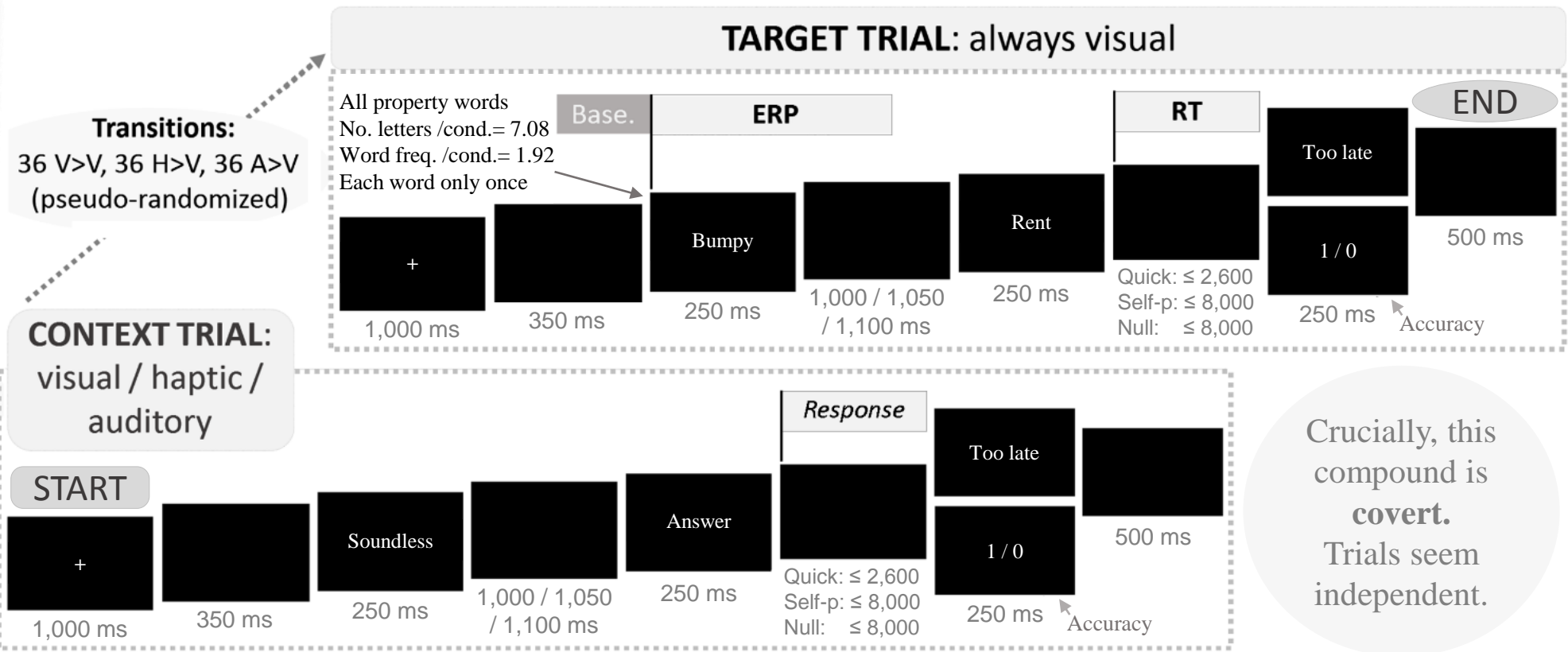
Result: even if orthogonal to the task, **CMS creates a processing cost** that gets picked up in ERPs and RTs.

Previously, **ERPs** were time-locked to last word in trial. **Study** [3]: An iron is hot || **Study** [4]: Candles flicker

✗ Un-controlled first word switch ✗ Lagged switch measurement ✗ Un-controlled relation concept, property

✓✓✓ **Solution:** **Time-lock to first word** in target trial, a property. Design is specific for ERPs, not RTs.

Test symbolic & embodied processing: A Quick-processing group would miss Haptic-to-Visual switch [7].



Stimuli norming [8]: $N = 42$. Rate 0 to 5 the auditory, haptic, visual strength of 747 words

Pretest: $N = 19$. Response accuracy = 63%.

Participants: Removed 1 ptp w/ errors > 50%

& 1 ptp due to too noisy ERPs.

Groups were pooled & re-split:

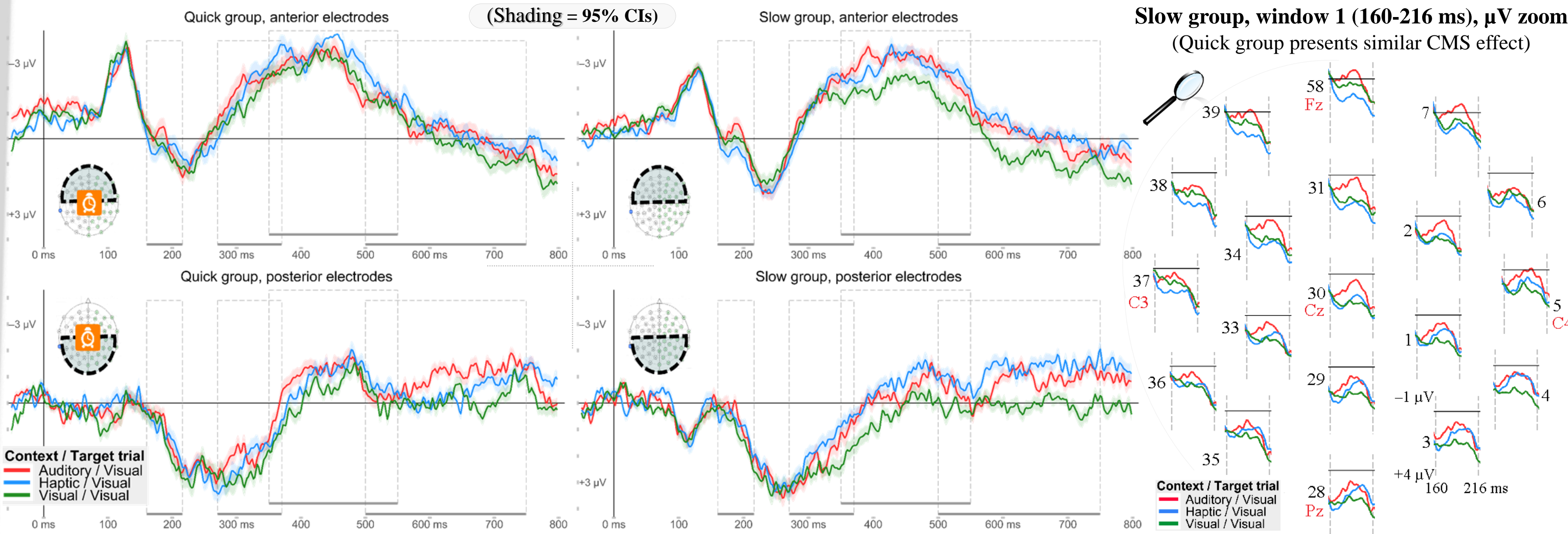
Final $N = 23$ Quick, 23 Slow. 37 ♀. Age=22.

Response accuracy: $M = 63\%$, $SD = 48$ pp.

Valid preprocessed: 78% ERPs, 99% RTs.

Poster & all data:
bit.ly/modswitch

RESULTS: CMS effect—negativity—appears broadly with both switch conditions, esp. in Slow Group & in Posterior area. Effect emerges in w1, then increases (final LME models' $R^2 = .748 - .862$), which converges with compatibility findings [7]. Group & CMS interact in w1 & w2. Interaction later as predicted, yet $p > .05$.



Main results per window. *** $p < .001$; ** $p < .01$; * $p < .05$

Window	Factors	Effect: χ^2
1	CMS	1.40
	CMS x Anterior/Posterior area	48.59***
	CMS x Ant/Pos area x Group	23.63**
2	CMS	6.40*
	CMS x Anterior/Posterior area	10.89**
	CMS x Ant/Pos area x Group	4.13***
3	CMS	9.47**
4	CMS	7.58*

CONCLUSION: CMS effect emerged in the first time window of word processing, providing further support for the role of perceptual simulation in conceptual processing (cf. [9, 10]). An increased CMS effect further in the time course suggests that distributional and embodied processes may be compatible (cf. [7]). More fundamental research on the time course of word comprehension may be beneficial.

Funded by Neurobiology of Language dept. of Max Planck Institute for Psycholinguistics, and by Experimental Psychology Society. Expert help from Gwilym Lockwood, Johan Weustink, Monique Flecken, Ronald Fischer, Sean Roberts, Brain Products™. Also, thanks to subjects.

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