Modality switch effects emerge early and increase throughout 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]:

Word onset || ~150 ms ~170 ms ~250 ms ~400 ms

Lexical | Semantic | Working memory | Response-related | Mental imagery | Episodic memory

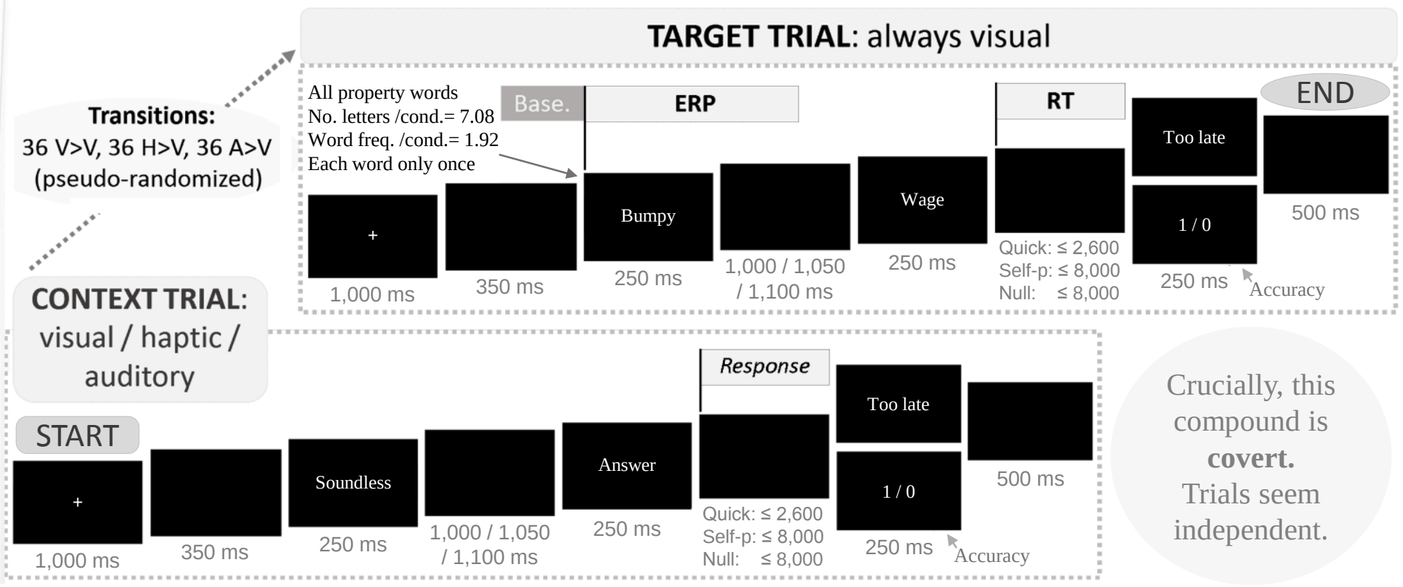
GOALS: Constrain time course of an effect, test distributional and embodied processing via CMS paradigm.

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].



Crucially, this compound is **covert.** Trials seem independent.

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

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

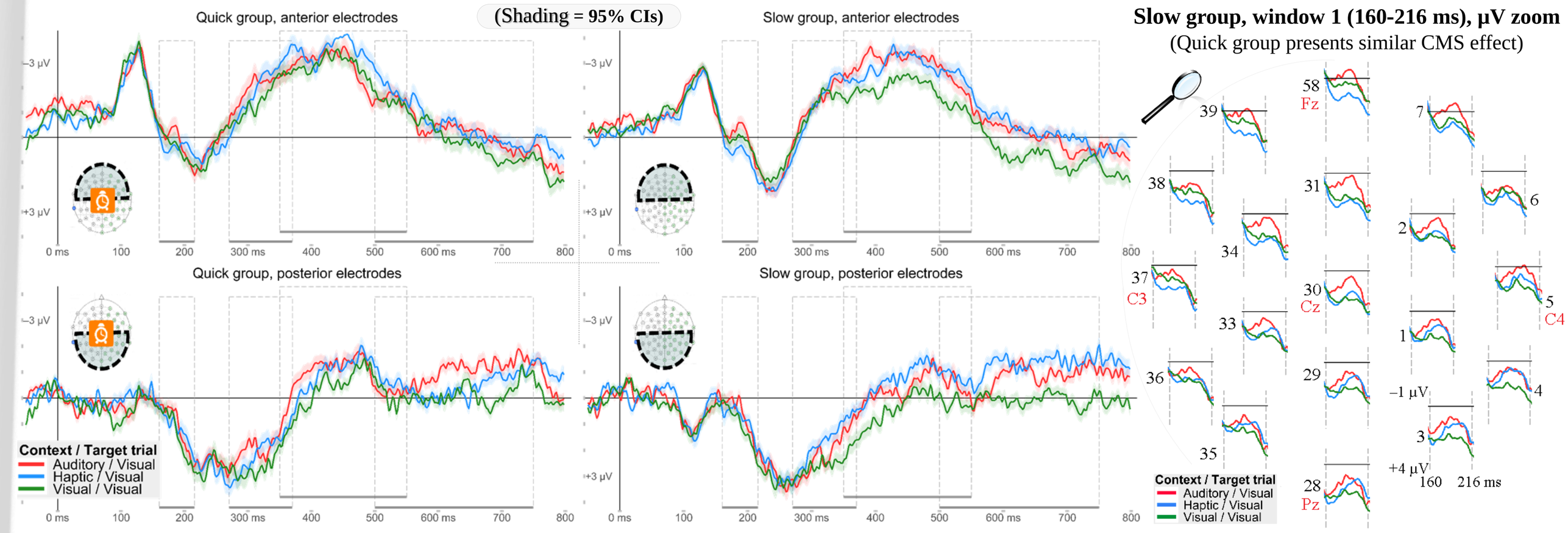
Participants: Removed 1 ptp w/ errors > 50% & 1 ptp due to too noisy ERPs. Groups were pooled & re-split: Final N = 23 Quick, 23 Slow. 37 ♀. Age=22.

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 benefitial.

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