Modality switch effects emerge early and increase throughout conceptual processing: Evidence from ERPs

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Engagement of sensory and motor brain regions during word recognition is well documented. Yet, 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]). **Yet, beware of levels** [6]

Word onset || ~150 ms ~170 ms ~250 ms ~400 ms … ~ 1s.

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

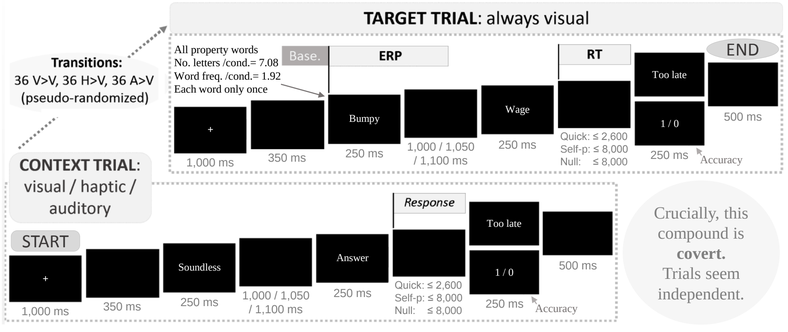
GOALS: Constrain time course of an effect, test distributional and embodied processing via CMS paradigm. Participants **verify the relation** between property and concept words. Covert: consecutive trials create conceptual **modality switches**. **Result:** Even if task orthogonal, **modality switching → processing costs →** Event-Related Potentials & Response Time.

Previous **ERP studies** time-locked to last word in target trials. Study [3]: An iron is hot || Study [4]: Candles flicker

✖ Uncontrolled switch effect at first word ✖ Lagged switch measurement ✖ Uncontrolled relation concept, property

✓✓✓ **Solution: Time-lock to first word** in target trials, a property. This makes design **specific for ERPs**, not RTs.

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



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

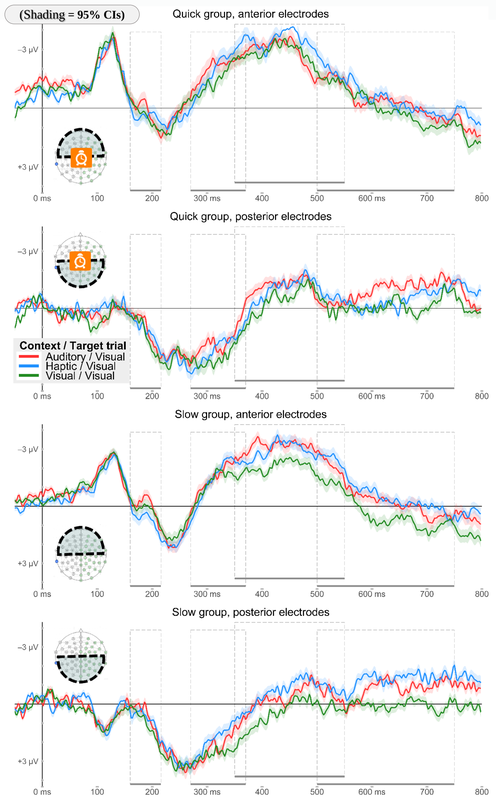
Stimuli norming [8]: N = 42. Rate on scale 0 to 5 the auditory, haptic, and visual strength of 747 words.

Pretest: N = 19. Response accuracy = 63%, SD=48pp

Participants: Removed 1 ptp w/ errors > 50% and 1 ptp due to too noisy ERPs. Because groups hardly differed in RTs, they were pooled & re-split, with a final: n = 23 Quick, n = 23 Slow. This operation was independent of the results (CMS effect very similar).

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

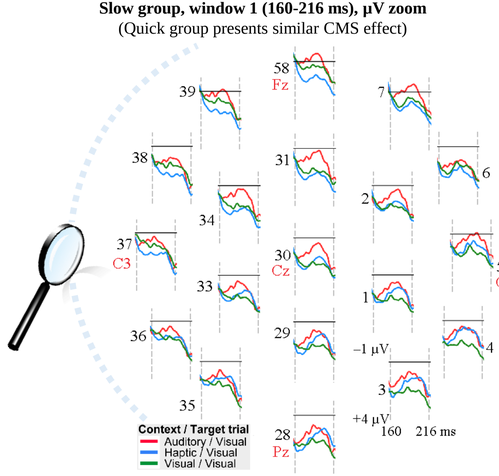
Valid preprocessed: 78% ERPs, 99% RTs.



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*

RESULTS AND CONCLUSIONS: 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.



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 word recognition research advised.

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