MODALITY-SPECIFIC LANGUAGE PROCESSING OF SPANISH MORPHOSYNTACTIC AND ORTHOGRAPHIC/PHONOLOGICAL VIOLATIONS: AN ERP STUDY

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While the effect of stimulus modality on behavioral performance is well-researched in psychology, its relevance in neurolinguistics is often underestimated, with the tacit assumption that language processing is largely modality-independent beyond its initial stages. However, we identify compelling evidence from five domains supporting the notion that stimulus modality significantly influences language processing post-sensory perception. These include functional neuroanatomy (distinct neural pathways for perception and mapping), temporal characteristics of sensory perception (instantaneous visual versus gradual auditory availability of information), the evolutionary development of reading (cortical exaptation and prevalence of reading disorders vs. listening disorders), the influence of sensory modality on information processing and retention (psychological modality effect, McGurk and Colavita effects), and modality-specific event-related potentials (ERPs) that perform similar cognitive functions (e.g., MMN and vMMN).

Understanding modality-specific language processing can shed light on the neural mechanisms of language comprehension, with implications for education, communication disorders, and assistive technologies. Therefore, our study investigates the existence of a neurophysiological modality effect in language processing.

Our research employs a multi-modal ERP paradigm to explore this effect in native language processing, testing two violation conditions: morphosyntactic and orthographic/phonological, representing varying levels of sensory modality dependency. Auditory ERPs are time-locked to the onset of the violated syllable to account for temporal differences between auditory and visual information availability. Eighteen native Spanish-speaking participants read and listened to Spanish sentences with subject-verb agreement violations and orthographic/phonological violations.

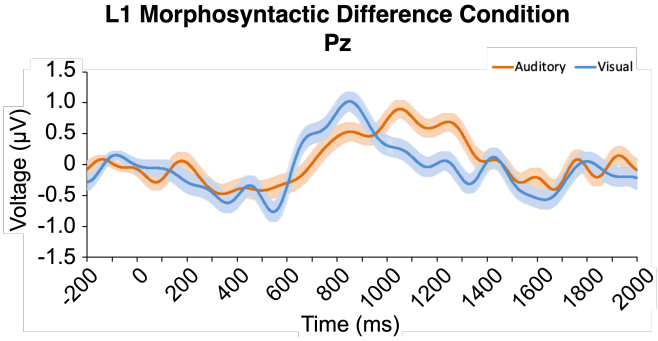

Figure 1: Morphosyntactic violation difference waveform (morphosyntactic violation minus control) showing the N400 and P600 in both modalities over Pz. For display purposes, the waveform is plotted with a low-pass filter at 6 Hz.

Our findings reveal neurophysiological modality effects in language processing in both violation conditions. Notably, the N400 is modality-independent, while the auditory P600 exhibits a more gradual and prolonged positivity than the visual P600 (Figure 1) in both violation conditions. In the orthographic/phonological violation condition, modality-specific effects are observed even during the N400 time window (across different regions), indicating heightened modality-specificity in orthographic and phonological processing. We additionally observed greater visual-evoked occipital negativity and greater auditory-evoked left frontotemporal negativity in both conditions, though varying in latency and distribution.

In conclusion, our results provide evidence for a combination of modality-dependent and -independent processes in language comprehension even post-sensory perception. We propose that while the N400 is modality-independent, the process(es) indexed by the P600 are partially modality-dependent and may include error backpropagation down to the representation level (which could explain how individuals adapt to variant pronunciations and handwriting styles). Taken together, these findings introduce of new perspective on the role that stimulus modality plays in language processing.