Negotiating global and domain-specific prediction in sentence processing: Neural evidence from aviation

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Using a domain-restricted language is often an integral part of being an expert. However, expertise rarely equates to simply knowing more words. While it has been shown that experts and non-experts exhibit different neural responses when processing domain specific languages [2,3], little has been done on the effect of deviations on expert language comprehension. In aviation, a completely fixed relationship exists between a term and its referent: users are taught that words (e.g. *climb*) should never be replaced with another synonymous referent (e.g. **ascend*). Nevertheless, nonstandard language use does occur, and even minor deviations (e.g. using *one hundred* instead of *one zero zero* for a heading) have serious consequences [1]. This suggests that, despite being trained to engage in domain-specific language exclusively, users of these specialised languages are unable to entirely repress activation of global language.

Using EEG combined with a word verification task (Figure 1), we investigated the interaction between global and domain-specific linguistic knowledge **in pilots and air traffic controllers** (N=26). Participants heard realistic[1] sentences in Aviation English (e.g. *ILS not available due equipment* __) with completions containing either standard phraseology (*failure*), nonstandard phraseology (**damage*), or semantically incongruent words (***paper*). Our aim was to elicit the N400, a neural marker that has shown sensitivity to semantic category deviations in sentence processing [4]: we hypothesised that, if global referents are indeed activated alongside domain-specific referents, then the N400 should be graded for the three conditions.

We found highly significant differences between all conditions ($p<.0001$*) in the N400 window (see Figure 2): experts exhibited a robust N400 effect to both nonstandard and incongruent stimuli, with larger amplitudes for incongruent sentences. Critically, this differed to results for non-experts (N=21, see Figure 2), who showed a delayed and reduced N400 only for the incongruent stimuli. Thus it appears that expert listeners may therefore generate predictions about what is *permissible* within the communicative system, such that nonstandard phraseology constitutes a violation of domain-specific expectations even when it remains semantically interpretable in general language.

[1] An example stimulus can be heard here: (https://osf.io/w489e/files/c5st2?view_only=731c46c435cd499fbda5b437dad2622b).

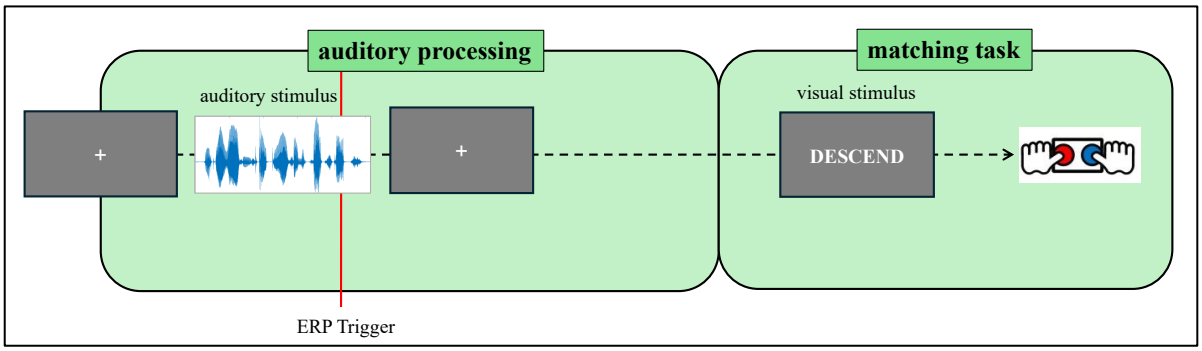

Figure 1: Task paradigm

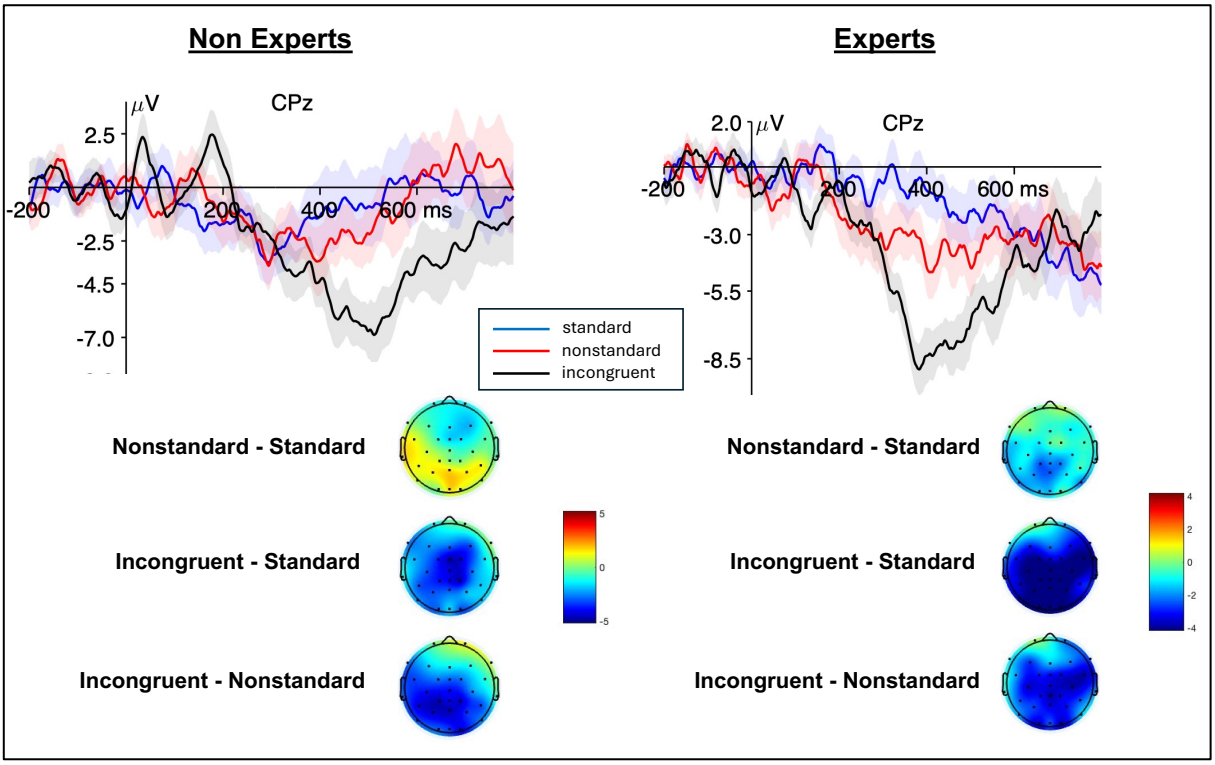

Figure 2: **Top:** Brainwaves time-locked to the critical word onset. **Bottom:** difference of difference topographic plots (350-550 ms).

References

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