[Q:] When would you prefer a SOSSAGE to a SAUSAGE?
[A:] At about 100 ms.
ERP correlates of orthographic typicality and lexicality in written word recognition

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Introduction

Written word recognition relies on different sources of information, which can be roughly classified into two kinds [1,2,3]:
i) **surface properties** (e.g. word length or frequency of letter combinations)
ii) **lexico-semantic properties** (e.g. word frequency or imageability).
This study aimed at dissociating the time courses and neural substrates of these processes.
Using a speeded **lexical decision** (LD) task, event-related potentials (**ERP**) and **minimum norm (MN) source estimates**, we investigated early spatio-temporal aspects of cortical activation elicited by **words and pseudowords** that varied in their **orthographic typicality**, i.e. in the **frequency of their component letter pairs** (bigrams) and triplets (trigrams).

Procedure and Methods

Task and Stimuli

14 subjects were confronted on each trial with a word or a pseudoword, and asked to press one button with the index finger of their left hand for words and with the middle finger of the same hand for pseudowords.
Quartets of stimuli were generated such that the surface-orthographic relationship between typical words (e.g. drew) and atypical pseudowords (driew) was identical to the one between atypical words (view) and typical pseudowords (vew) (see table below). The crucial manipulation was that, in one pair of each matched quartet, the word was less orthographically typical (as measured by bigram and trigram frequencies) than its partner. **Each category comprised 50 items**. These were matched for length, frequency, RT/accuracy (typical vs. atypical), and number of pseudo-homophones.

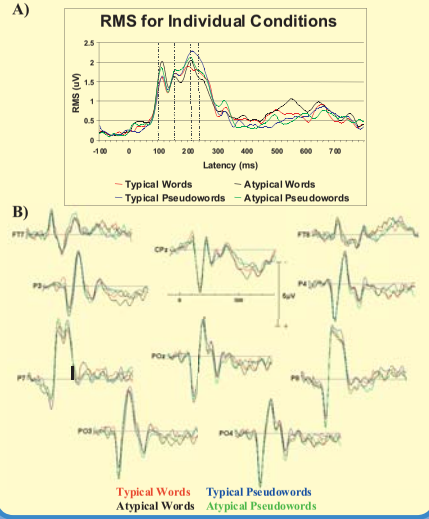
	Typical	Atypical
Word	Drew	View
Pseudoword	Vew	Driew

ERP analysis and source estimation

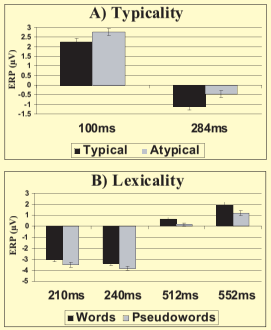
63 EEG and 2 EOG channels (Neuroscan). Bandpass 1-20Hz. Average reference. Baseline 100ms. Artefact threshold 100uV. Only trials with correct responses were analysed.
Peaks in RMS curves were selected, and amplitudes at peak electrodes subjected to **2-by-2 ANOVAs**.
Furthermore, **p-value distributions** are presented as post-hoc tests and to test for specificity of effects.
MN source estimates [4] were computed on grand-mean data before subtraction. Only values with SNRs larger than 2 are shown.

Results

Time course of ERP data:
A) Root-Mean-Square and **ERP** curves for individual conditions. Latencies selected for analysis are marked for the **RMS** curves.
B) Voltage curves for selected electrodes.

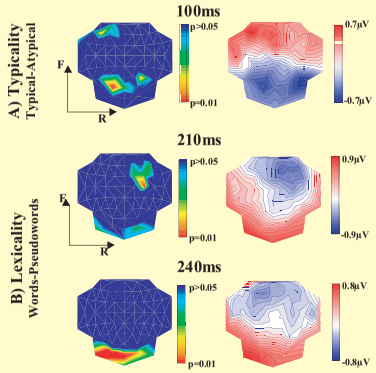


Bar graphs with standard errors for significant **main effects of the ERP analysis**.
Grand-mean voltages are plotted for electrodes at peaks in the ERP distribution at the corresponding latencies.
A) **Main effects of typicality**.
B) **Main effects of lexicality**.

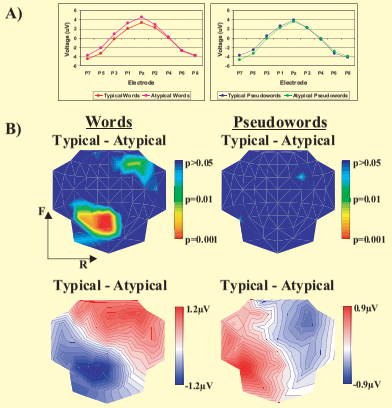


Results

ERP topographies of early main effects:
Maps were interpolated and projected on a two-dimensional plane. The p-values based on paired 2-tailed t-tests are shown on the left, while the corresponding ERP amplitudes are presented on the right. F: Front; R: Right.
A) **Main effect of Typicality at 100ms**.
B) **Main effects of Lexicality at 210ms and 240ms.**

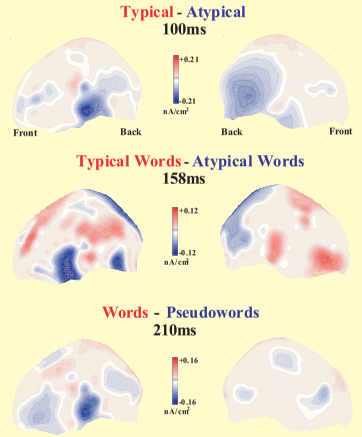


Interaction between Lexicality, Typicality and Laterality at 158ms:
A) Grand-mean voltages are plotted for selected posterior electrodes as a function of electrode, lexicality and typicality.
B) Statistical parametric maps (top) and ERP topographies (bottom) for the Typicality contrast, separately for words (left) and pseudowords (right).



Results

Source estimates
computed on the grand-mean ERP displayed for the left and the right hemisphere, respectively. Red and blue colours distinguish the direction of effects according to labels within each figure.



Conclusion

The **earliest ERP effect of typicality** was observed **at ~100ms** (atypical>typical), and the earliest effect of **lexicality at ~200ms** (pseudowords>words). The main cortical sources of both effects were localised in **left inferior temporal cortex**. The two factors **interacted significantly at ~150ms**, with a typicality effect for words but not pseudowords. Typical words activated perisylvian regions bilaterally, whereas **atypical words elicited stronger source currents in left anterior inferior temporal cortex**: the latter region is **the main site of atrophy in patients with semantic dementia**, who have particular difficulty recognising atypical words [1]. Our data suggest **distinct but interactive processing stages in written word recognition**, with the interaction reflecting integration of information from the earlier form-based system and later lexico-semantic processes.

References

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