

Early effects of morphological complexity in visual word processing: An MEG study



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Introduction

Models of lexical access differ in the timing of lexical decomposition. Taft & Forster (1975) originally proposed that affixes are stripped from morphologically complex words before lexical access. Recent masked priming research by Rastle, Davis & New (2004, *PBR*) provides further support for this model. In this study, we used Magnetoencephalography (MEG) to examine the time course of morphological decomposition.

The earliest MEG component that might show effects of morphology is the M170, as its LH generator has been identified as the first locus of letter-string specific processing (Tarkiainen et al 1999, *Brain*). We tested **1. Whether the M170 shows effects of morphological complexity** **2. Whether such an effect would be modulated by semantic transparency.**

Experiment 1 - Suffixes

We used 4 conditions of 34 words each, based on two criteria – morphological complexity and semantic opacity. Conditions were controlled for length, orthographical neighborhood density and frequency, and syntactic category. The suffixed conditions were further controlled for stem frequency and orthographical regularity.

No Suffix	No Suffix Orth. -er	Opaque Suffix	Transparent Suffix
SWITCH	WINTER	FOLDER	FARMER

Experiment 2 - Prefixes

In order to test whether the laterality of the first experiments results had to do with the order of presentation of stem and affix, we repeated the experiment with prefixes. We used 3 conditions of 32 words each, based on morphological complexity. Conditions were controlled for length, orthographical neighborhood density and frequency, and syntactic category. The suffixed conditions were further controlled for stem frequency and orthographical regularity.

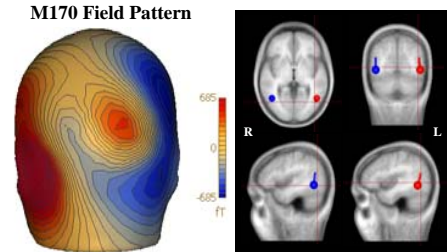
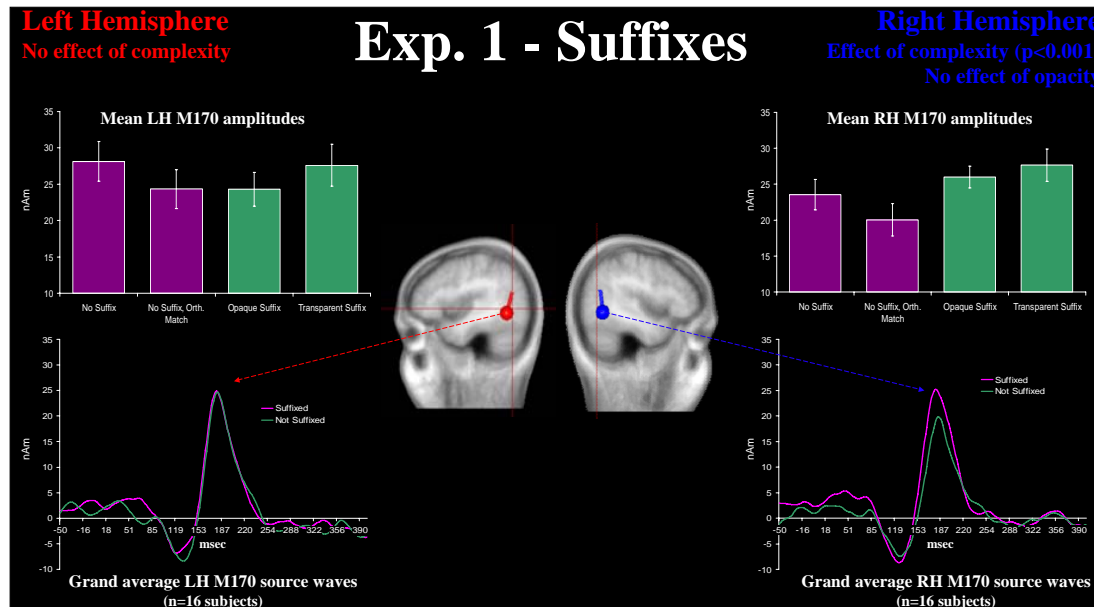
No Prefix	No Prefix Orth. re-	Prefix
ROTATE	RESUME	REFILL

Methods

Task: Lexical decision.

MEG recording: 148-channel neuromagnetometer (4-D Neuroimaging, Magnes WH 2500). Sampling rate: 678 Hz. Recording band: .1- 200Hz.

Data analysis: Due to significant overlap between the bilateral magnetic fields for early word-processing activity (M170), it is difficult to model the sources in the two hemispheres as separate dipoles using standard multi-dipole modeling. fMRI studies provide robust evidence that the left fusiform gyrus (Talairach coordinates $x=-42, y=-57, z=-6$) shows a letter-string effect (Cohen et al. (2000), Dehaene et al (2002)). Therefore, we placed dipoles in the fusiform gyri bilaterally. This is consistent with MEG localization when bilateral sources are obtained.



Conclusion

These results show that M170 activity is influenced by morphological complexity, lending support to the hypothesis that lexical decomposition occurs early. This effect is shown to be truly sensitive to morphology and not to orthographical homologues of the suffixes. It is also shown to occur regardless of the semantic opacity of the suffix, lending support to the view that all affixed words decompose. Interestingly, for suffixed words, the M170 effect is right lateralized, but for prefixed words it is bilateral. Given that previous MEG results (Tarkiainen et al 1999) show that letter-string effects are left-lateralized, this suggests that early visual word processing may be bilateral, with distinct functional roles for the left and the right hemispheres.

