

Chinese Abstract Verbs and Nouns Electrified: Electrophysiological Evidence for Grammatical Class Differences at Single Word Processing Level

Kevin Tang¹, Ye Tian³, Emma-Louise Schwabe¹, Jyrki Tuomainen², and Judit Druks¹

¹University College London, Linguistics, ²Speech, Hearing and Phonetic Sciences, United Kingdom

³Laboratoire de linguistique formelle, Université Paris Diderot, France

kevin.tang.10@ucl.ac.uk, tiany.03@googlemail.com, emma@d-hauser.de, j.tuomainen@ucl.ac.uk, j.druks@ucl.ac.uk



Motivation

- No consensus as to whether the production and comprehension of single nouns and verbs activates information about their grammatical class
- Difficult to find evidence of nouns and verbs as grammatical categories
- Confounded with semantic categories (of objects and actions), levels of imageability (lower for verbs than nouns) and affective norms (Vigliocco et al., 2011)
- Circumvented by using abstract nouns and verbs with no emotional content

Druks and Tuomainen (submitted): Task dependent Event-Related Potential (ERP) activation of grammatical class between abstract nouns and verbs only in a grammatical class judgement task but not in a lexical decision task (LDT).

Hauser et al. (2012): The lack of a difference in the LDT was due to a mixed set of concrete and abstract items. In an LDT using only abstract nouns and verbs showed a significant RT difference (**verbs faster than nouns**), and a late positive ERP response (less positive to verbs than nouns, 600-750ms) suggesting that **grammatical class information was accessed post-lexically even at single word level.**

Research Aims

- Cross-language evidence for the grammatical class distinction
- Language-specific differences between Mandarin Chinese and English

Analyses

Preprocessing

- Remove artefacts, and average by nouns/verbs/pseudowords (EEGLAB and ERPLAB)
- ERP waveforms were calculated for each channel and each participant.

Modelling

- Mixed effects model (*lmer*; Bates, Maechler, Bolker, & Walker, 2014) with fixed effects, grammatical class (noun vs. verb) and channel (except mastoids, eyes, and IZ), with participant as the random effect, predicting amplitude (See Figure 1)
- A data-driven approach to model selection. Starting with a saturated model, with fully specified random effects. The best model was selected through nested model comparisons
- **Best model:** $amplitude \sim grammatical\ class + channel + (1 + grammatical\ class | participant)$
- *grammatical class* remained to be a significant predictor, $|t| = 2.564$

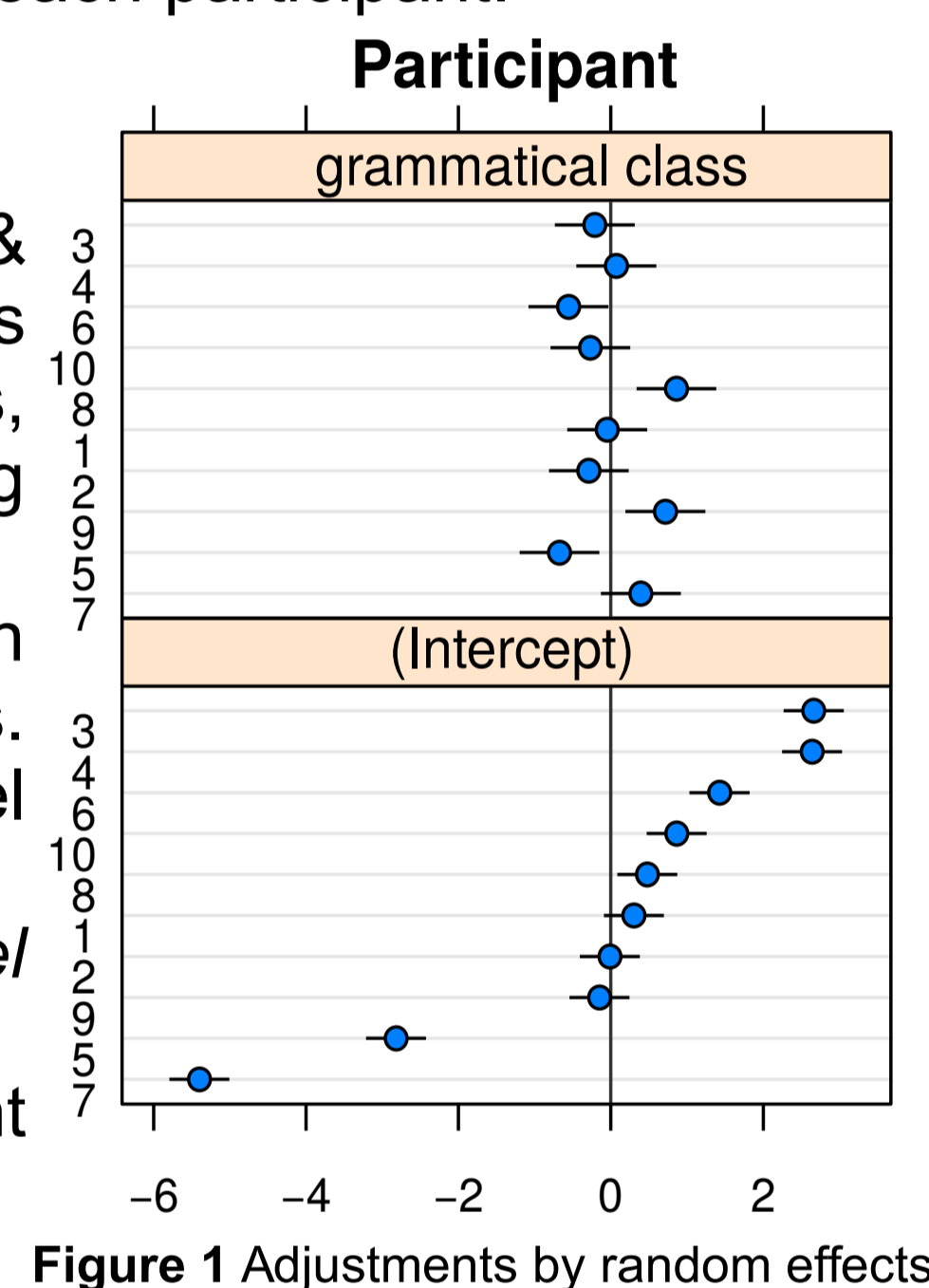


Figure 1 Adjustments by random effects

Results and Discussion

The results showed that verbs, in contrast to the English study, were responded to slower than nouns, and in accordance, the late positive ERP response (in the 630-790 ms) was smaller for nouns than verbs. The time frame is similar to Hauser et al. again suggesting that grammatical class information is accessed when single words are perceived. (See Figure 2 and Figure 3)

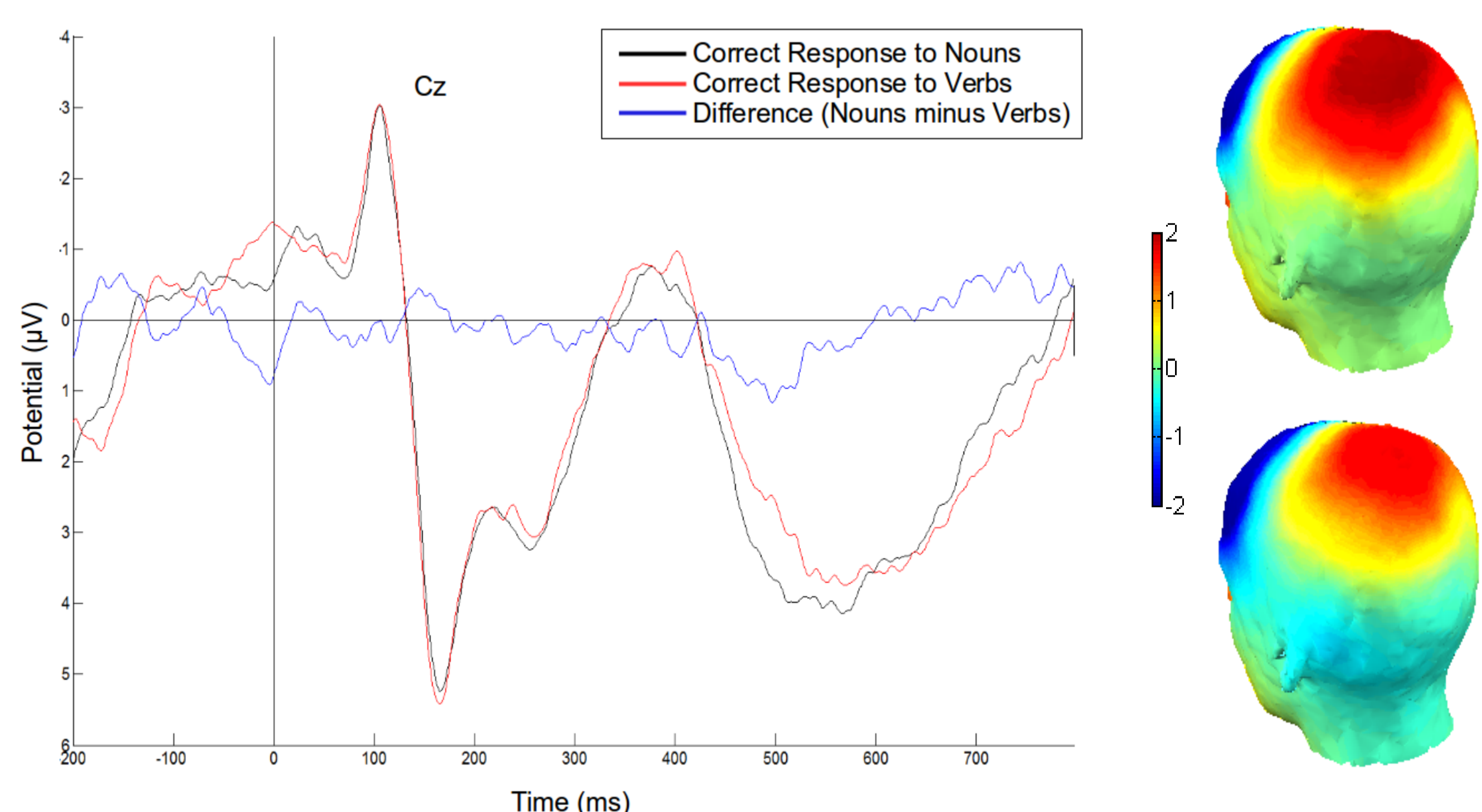


Figure 2 shows the ERP responses (at Cz) to nouns (black) and verbs (red) and the difference wave (blue).

Figure 3 show the scalp distribution of the mean amplitude between 630-790ms for verbs (top) and nouns (bottom).

Task: Lexical Decision

- 160 pseudo words, 160 real words (80 nouns and 80 verbs)
- All items randomised
- 10 native Mandarin Chinese speakers from mainland China
- Collected behavioural (RT) and ERP responses (64 channels)

Methods: Controls and Stimuli Selection

Source words

- Sampled ~1000 disyllabic Mandarin Chinese nouns and verbs
- Pruned items with an ambiguous grammatical class ("to kick" vs. "a kick")
- Categorized into abstract/concrete and noun/verb
- 850 items remained

Enriching

- No psycholinguistic database for disyllabic Chinese words
- Valence
- Imageability (Stadthagen-Gonzalez, & Davis, 2006)
- Token Frequency (Cai, & Brysbaert, 2010)
- Stroke counts
- Orthographic neighbours (1-edit distance: Character)
- Phonological neighbours (1-edit distance: Consonants, Vowels, Tones)

Affective norms Valence 850 items were split into 8 lists. Each completed by ~26 participants voluntarily, recruited at UCL. Participants were removed if a) correlated poorly with the mean of other participants, b) those outside 2.5 std from the mean, with 166 participants remaining.

Exclusion of Arousal and Dominance Arousal was shown to be an insignificant variable for lexical processing once other variables such as token frequency are taken into account (Vinson, Ponari, & Vigliocco, 2014), and b) Dominance was found to correlate ($R = 0.717$) highly with Valence (Warriner, Kuperman, & Brysbaert, 2013).

Imageability 850 items were split into 2 lists, each completed by 100 participants voluntarily, recruited in a Chinese university. Similar participant-pruning was done as with the Valence data, with 152 participants remaining.

Stimuli selection

- 80 abstract nouns and verbs were selected
- 80 pseudo words were generated
- Lexical variables were balanced for nouns vs. verbs, and real vs. pseudo

Controls	Verb	Noun	t-value	p-value
Imagineability	3.496	3.465	0.362	0.718
Valence (Abs, Centered)	1.089	1.043	0.632	0.528
Word Token Freq. (log10)	2.372	2.359	0.134	0.894
1st Char. Freq. (log10)	4.070	4.212	-1.685	0.094
2nd Char. Freq. (log10)	4.151	4.099	0.609	0.543
Abs. Diff. Char. Freq. (log10)	4.288	4.117	1.946	0.054
Sum Char. Freq. (log10)	4.587	4.571	0.286	0.775
1st Char. Stroke	8.763	8.063	1.459	0.147
2nd Char. Stroke	8.900	8.550	0.658	0.511
Abs. Diff. Char. Stroke	-0.138	-0.488	0.494	0.622
Sum Char. Stroke	17.663	16.613	1.451	0.149
Orthographic Neighbours	70.375	78.925	-1.311	0.192
Phonological Neighbours	4.413	4.856	-0.736	0.463

Future Directions

- Increase the sample size to 20
- Examine an earlier time frame (400ms – 600ms)
- Reanalyse with Generalized Additive Model on trial-level data to include by-item random effects and lexical controls
- Tighten controls: Age of Acquisition, Concreteness, PLD/OLD20

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