Supplementary material

The ERP response to the amount of information conveyed by words in sentences

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1 Models' linguistic accuracy

Figure 1 displays how the models' linguistic accuracy develops as the models are trained on an increasingly large data set (for RNN and PSG models) or as the order n increases (for n-gram models). There are 10,000 word types in the selected BNC training corpus, so a model with no knowledge of the language would have a linguistic accuracy of $\log(1/10,000) = -9.21$. For the parts-of-speech models, this baseline is $\log(1/45) = -3.81$

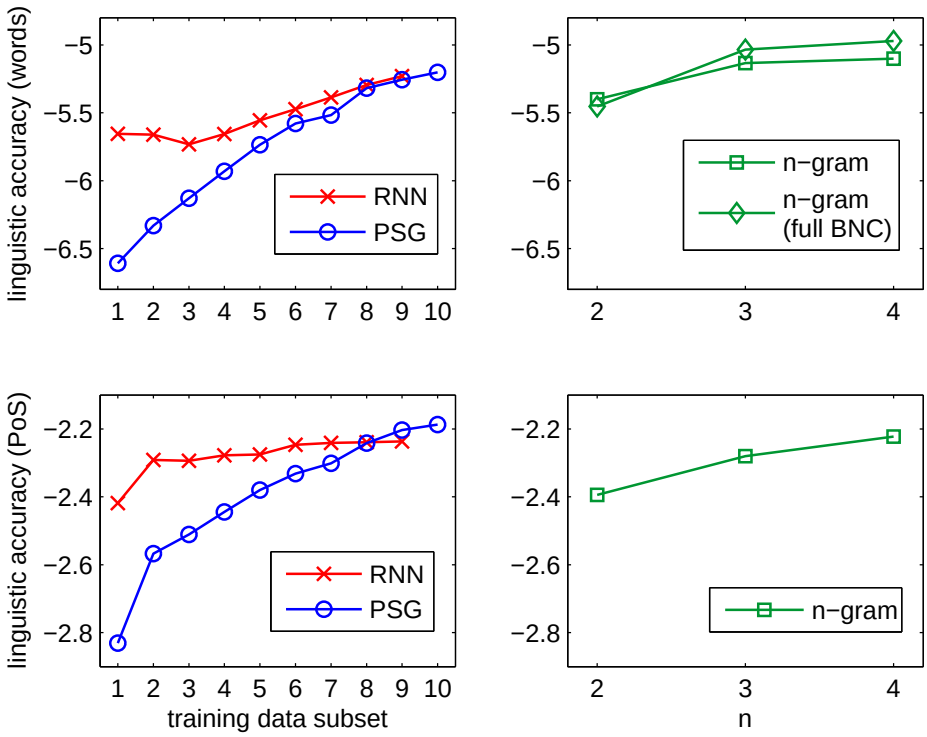

Fig. 1: Linguistic accuracy (average $\log P(w_{t+1}|w_{1...t})$ over experimental sentences) of each language model, defined over words (top row) or parts-of-speech (bottom row). 'Training data subset 10' referes to the full training corpus (i.e., subset 9) presented twice to the RNN model.

2 Correlation between baselines and ERP amplitudes

Table 1 presents the coefficients of correlation between each ERP's baseline and component amplitude, for different cut-off frequencies of the additional high-pass filter.

Table 1: Correlations between ERP baselines and component amplitudes, for different high-pass filters.

	ERP component					
Filter freq. (Hz)	ELAN	LAN	N400	EPNP	P600	PNP
(none)	.796	.522	.538	.756	.620	.583
0.25	.265	.360	.291	.419	.255	.160
0.33	.190	.295	.228	.352	.159	.087
0.50	.089	.190	.138	.248	.022	−.018

3 Exploratory analysis results

Each of the four Figures 2 to 5 shows the fit to ERP amplitudes of one of the four information measures: word surprisal, PoS surprisal, word ΔH, and PoS ΔH, respectively. Plotted are the χ^2-statistics for individual language models as a function of each model's linguistic accuracy. Negative values indicate effects in the negative direction. Dotted lines indicate $\chi^2 = \pm 3.84$, the critical value at the $\alpha = .05$-level, which must not be taken as an indication of statistical significance because of the exploratory nature of these results.

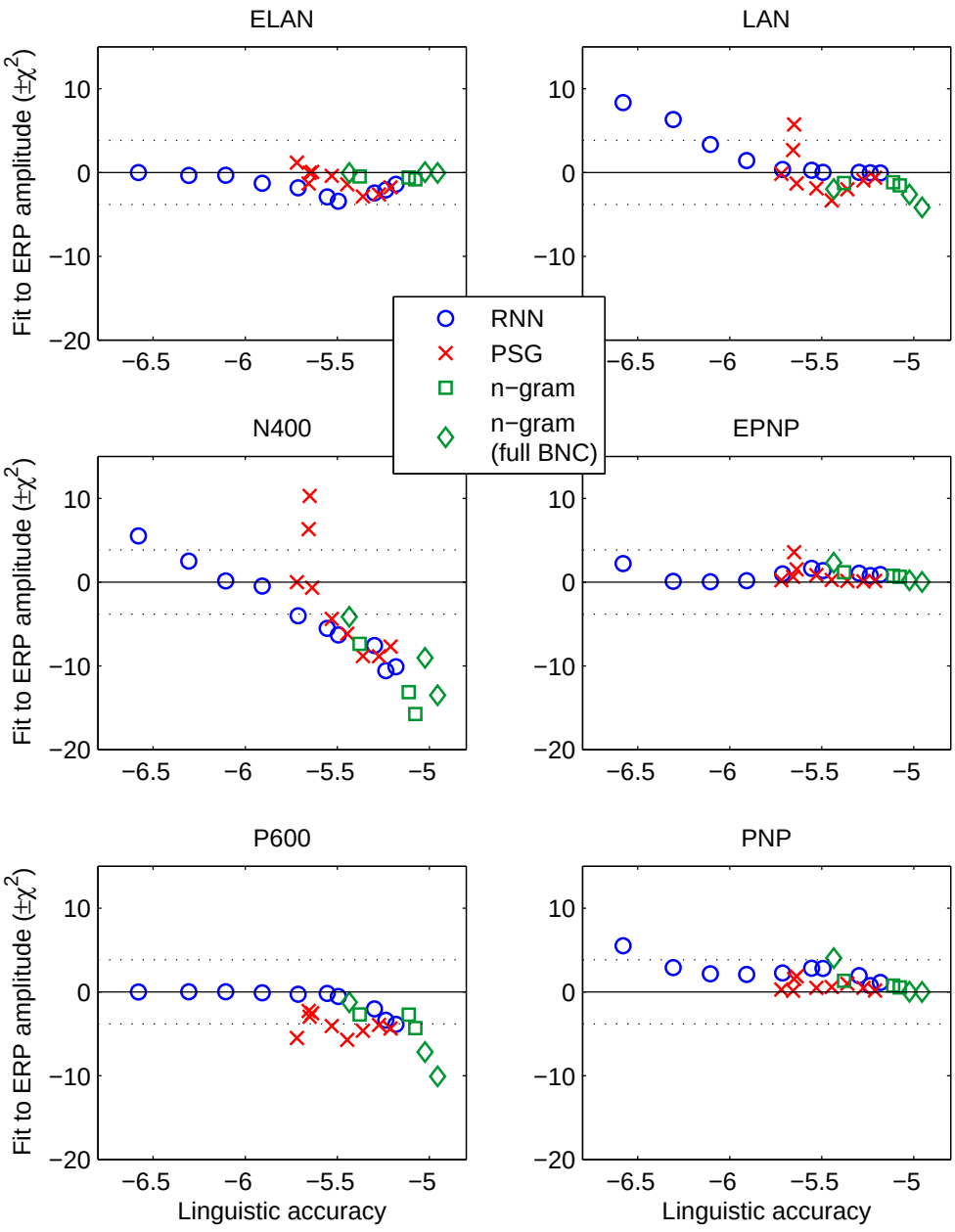

Fig. 2: Fits of all models' word surprisal to the amplitudes of different ERP compontents.

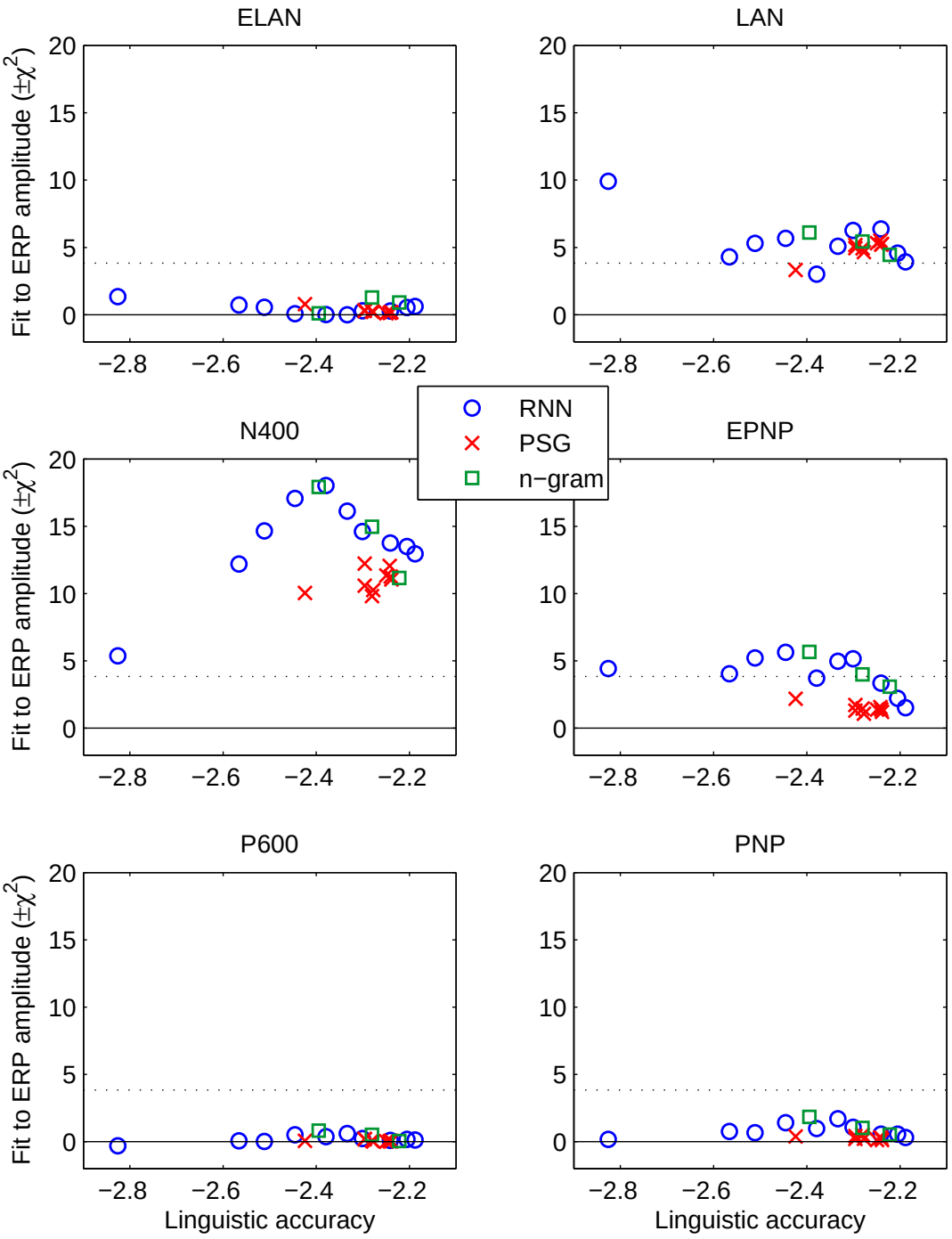

Fig. 3: Fits of all models' PoS surprisal to the amplitudes of different ERP compontents, over and above word surprisal under a 4-gram model trained on the full BNC corpus.

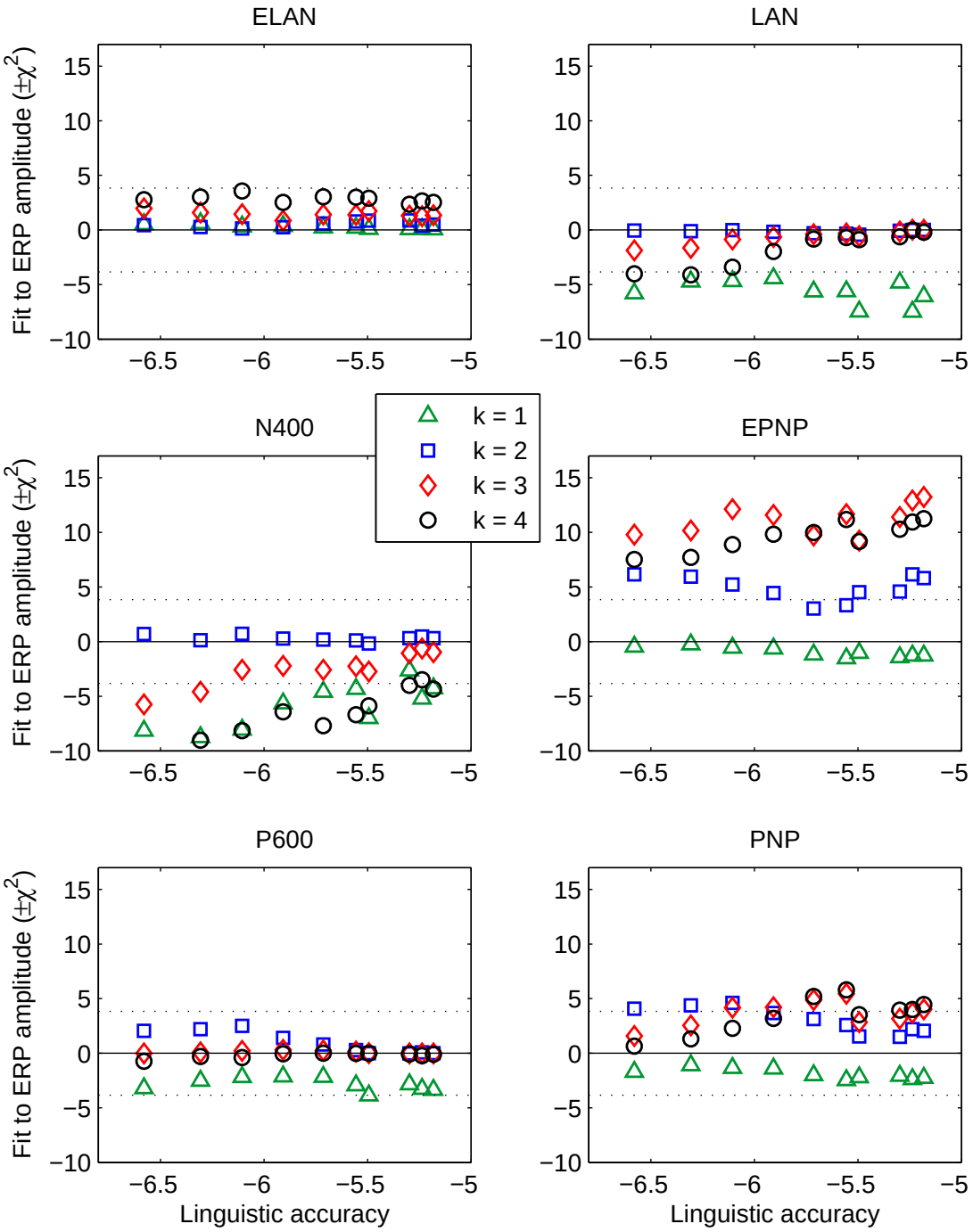

Fig. 4: Fits of RNN models' word entropy reduction (for different levels of the lookahead distance k) to the amplitudes of different ERP compontents, over and above word surprisal under a 4-gram model trained on the full BNC corpus.

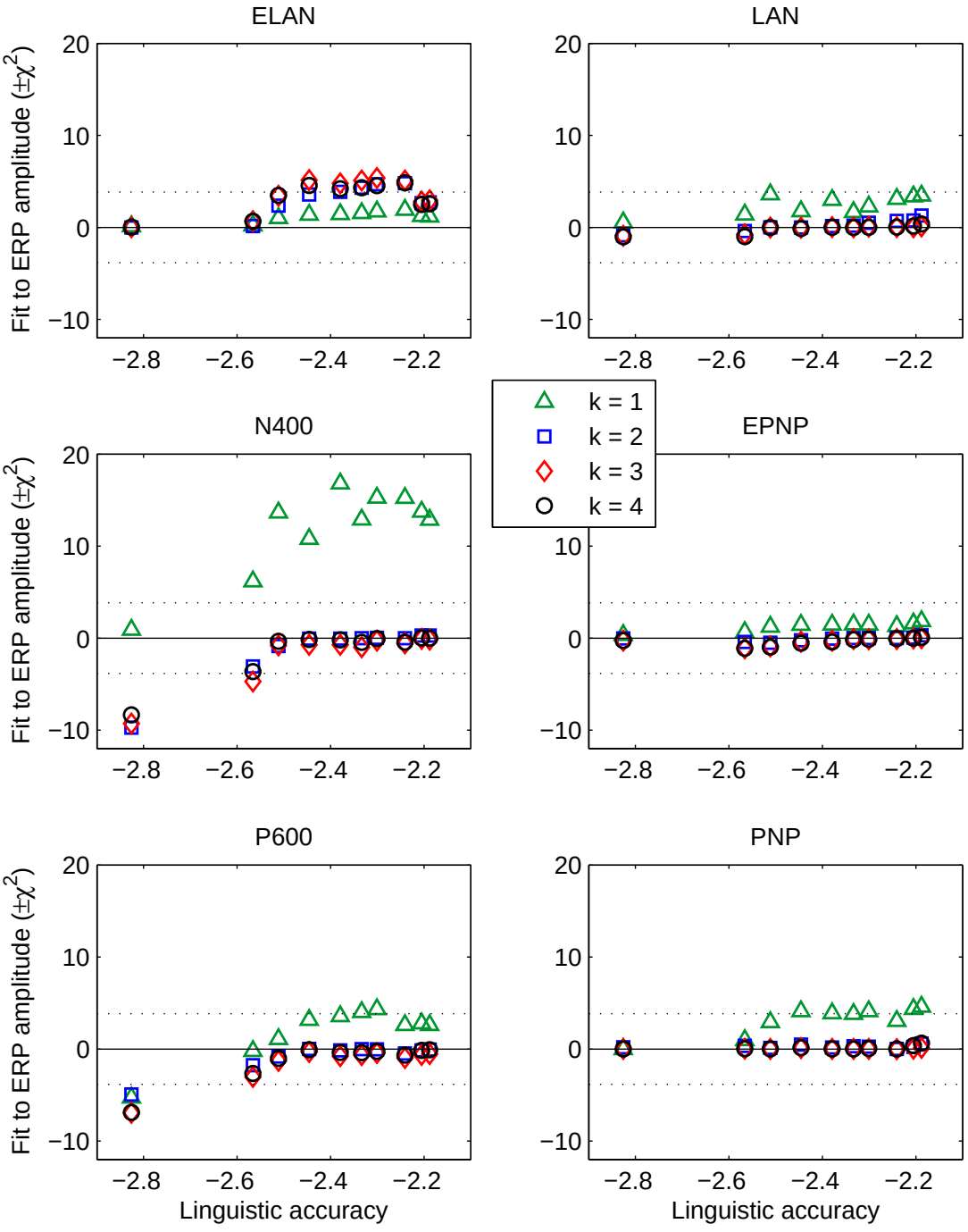

Fig. 5: Fits of RNN models' PoS entropy reduction (for different levels of the lookahead distance k) to the amplitudes of different ERP compontents, over and above word surprisal under a 4-gram model trained on the full BNC corpus.