1

Statistical Cues for Sentence Boundaries

surprisal distribution   **entropy distribution**
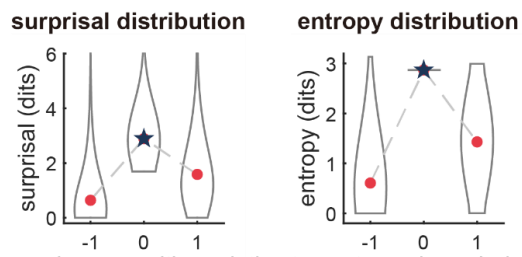
2   morpheme position relative to sentence boundaries

3   **Figure S1. Surprisal and entropy distribution at sentence boundaries for**
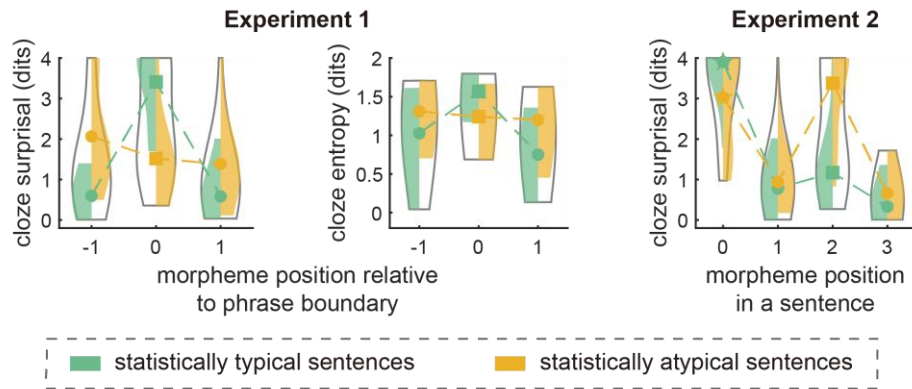4   **all NP-VP sentences in corpora.**

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A *Surprisal and Entropy Estimated Based on Human Cloze Probability*

Experiment 1 — cloze surprisal (dits), cloze entropy (dits); morpheme position relative to phrase boundary

Experiment 2 — cloze surprisal (dits); morpheme position in a sentence

statistically typical sentences   statistically atypical sentences

B *Correlation Between Human Cloze Surprisal and GPT Surprisal*

Experiment 1

noninitial
R=0.84; P=2x10⁻⁵⁸

phrase-initial
R=0.77; P=6x10⁻¹³

sentence-initial
R=0.38; P=0.005

boundary-effect

cloze surprisal   MEG response

Experiment 2

noninitial
R=0.78; P=1x10⁻³⁷

phrase-initial
R=0.78; P=3x10⁻¹⁹
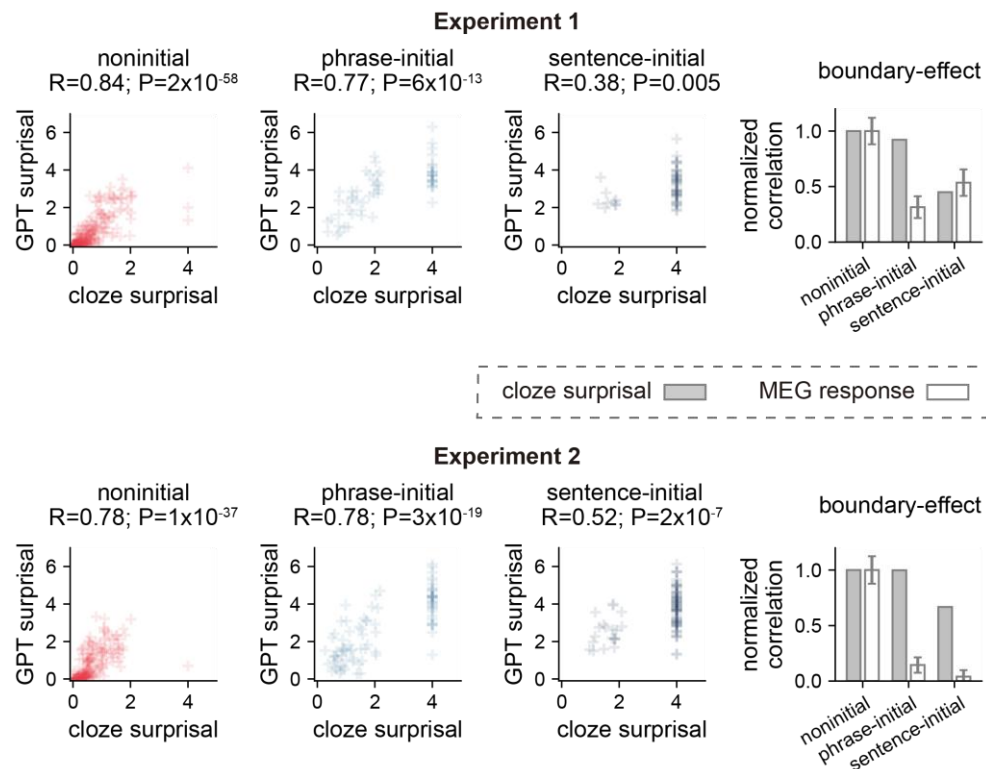
sentence-initial
R=0.52; P=2x10⁻⁷

boundary-effect

Figure S2. Human morpheme prediction under a cloze task for materials in Experiments 1 and 2. (**A**) Surprisal and entropy estimated based on the cloze probability, for statistically typical and atypical sentences. Results for Experiments 1 and 2 are shown using the same setup in Fig. 2B and Fig. 4B. Results of the cloze task confirm distinctions between statistically typical and atypical sentences. (**B**) Correlation between cloze-probability-based surprisal and GPT surprisal and the influence of chunk boundaries. This analysis mirrors the analysis on the MEG M400c amplitude, except that the M400c amplitude is replaced by the surprisal estimated based on the cloze task. The left three panels show scatter plots for individual morphemes (*R*: spearman correlation coefficient; *P*: significance level). The rightmost panel shows the correlation normalized based on the correlation of noninitial morphemes. The

21 correlation is comparable for noninitial and phrase-initial morphemes, and is
22 lower for sentence-initial morphemes. The sentence-boundary effect is also
23 weaker than what is observed in the MEG experiments.

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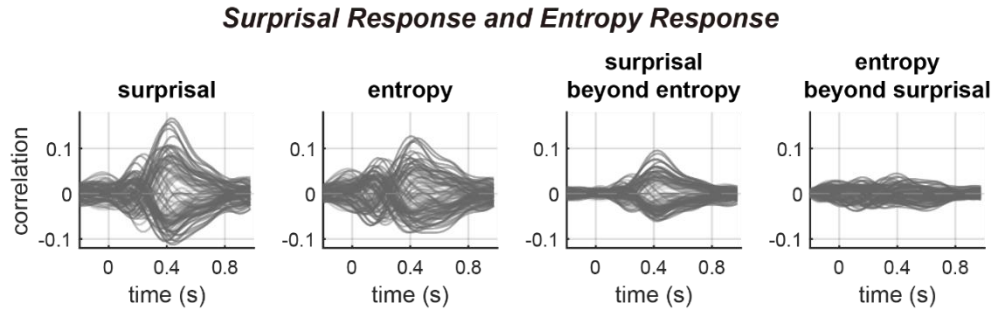
27
28 **Figure S3. Time-wise correlations characterizing the response to**
29 **surprisal and entropy.** The first (second) panels show the partial correlations
30 between the neural responses and surprisal (entropy), with surprisal (entropy)
31 of 2 preceding and 2 following morphemes included as co-variables. The third
32 (fourth) panels show the unique contribution of surprisal (entropy) when
33 entropy (surprisal) is included as a co-variable. All plots are averaged across
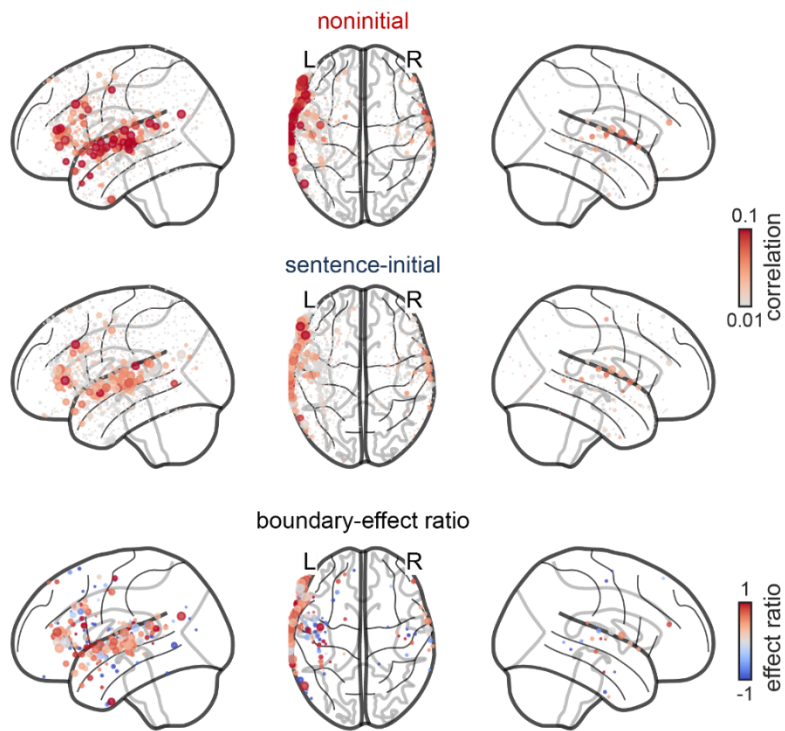34 participants. Each curve represents one sensor.

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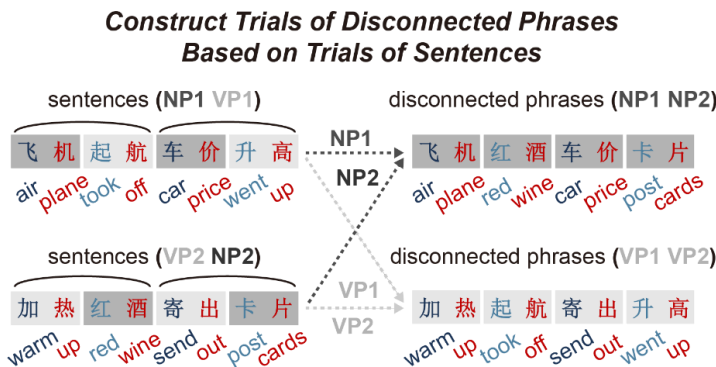
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40 **Figure S4. Construction of disconnected-phrase condition.** Trials of
41 disconnected phrases are constructed based on sentence trials: For a NP+VP
42 trial and a VP+NP trial, NPs are rearranged to create a NP trial, while VPs are
43 used to form a VP trial. Both the disconnected-phrase condition and sentence
44 condition use the same set of phrases, and each phrase is presented at the
45 same positions. For instance, "车价 car price" consistently appears as the
46 third phrase in a trial.

Neural-Surprisal Correlation for Single Electrodes

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Figure S5. Enlarged view of Fig. 7B.

A *Calculate Surprisal with Periods After Each Sentence*
(*...A gust of wind blew away the mist <period> small fishing boats continued...*)

B *Calculate Surprisal Without Periods After Each Sentence*
(*...A gust of wind blew away the mist small fishing boats continued...*)

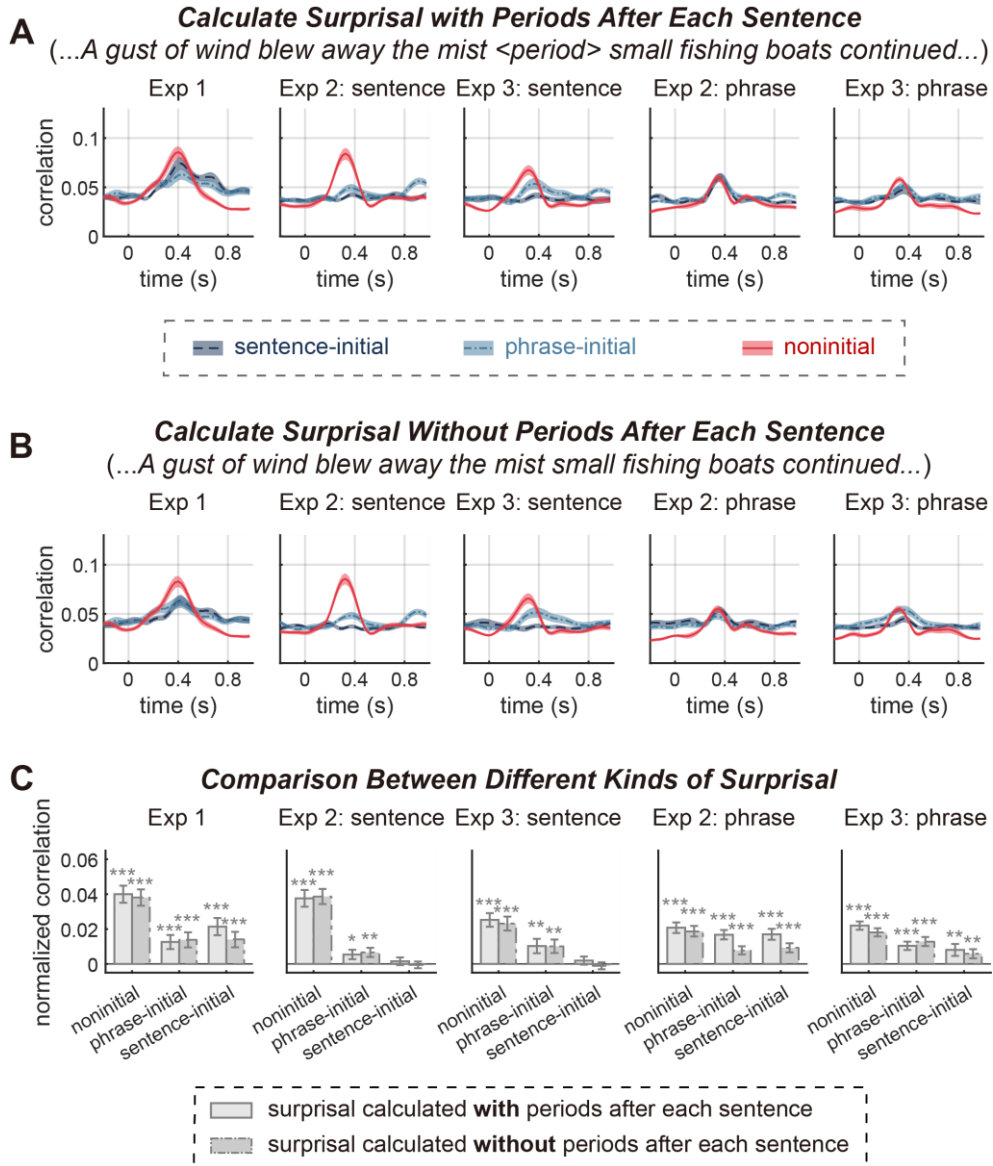**C** *Comparison Between Different Kinds of Surprisal*

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Figure S6. Surprisal response and chunk boundary effects when surprisal is calculated with (A) or without (B) periods after each sentence. Examples of inputs to GPT-2 are shown in brackets. (**C**) Comparison of correlations to neural response for both kinds of surprisal. The patterns observed are similar, with slightly higher correlations when periods are considered. Error bars denote the SEM across participants ($N = 17$ for Experiment 1; $N = 19$ for Experiments 2 and 3). Values significantly higher than chance are marked by stars. *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.