

FIGURE S1

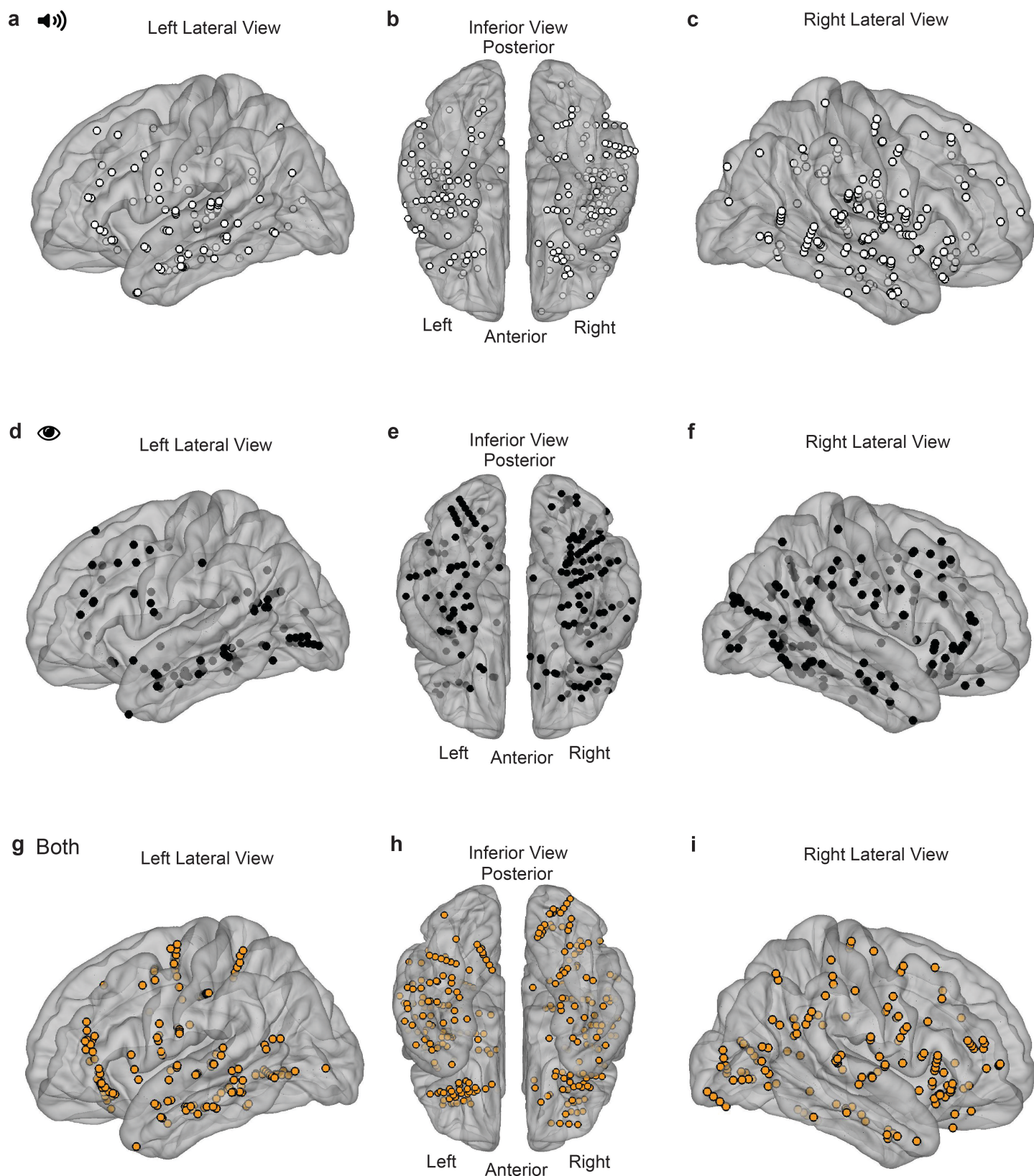


Fig. S1 | Location of responsive electrodes. **a-c.** Only audio responsive electrodes (**a**: left hemisphere lateral view, $n = 102$; **b**: inferior view ($n=272$); **c**: right hemisphere lateral view, $n = 170$). **d-f.** Only visually responsive electrodes (**d**: $n = 85$; **e**: $n=239$; **f**: $n = 154$). **g-i.** Audiovisual responsive electrodes (**g**: $n = 147$; **h**: $n=293$; **i**: $n = 146$). The same color scheme is followed throughout the paper to indicate vision-only, audio-only or audiovisual electrodes. iELVis pullout factor=20, opaqueness=0.6.

FIGURE S2

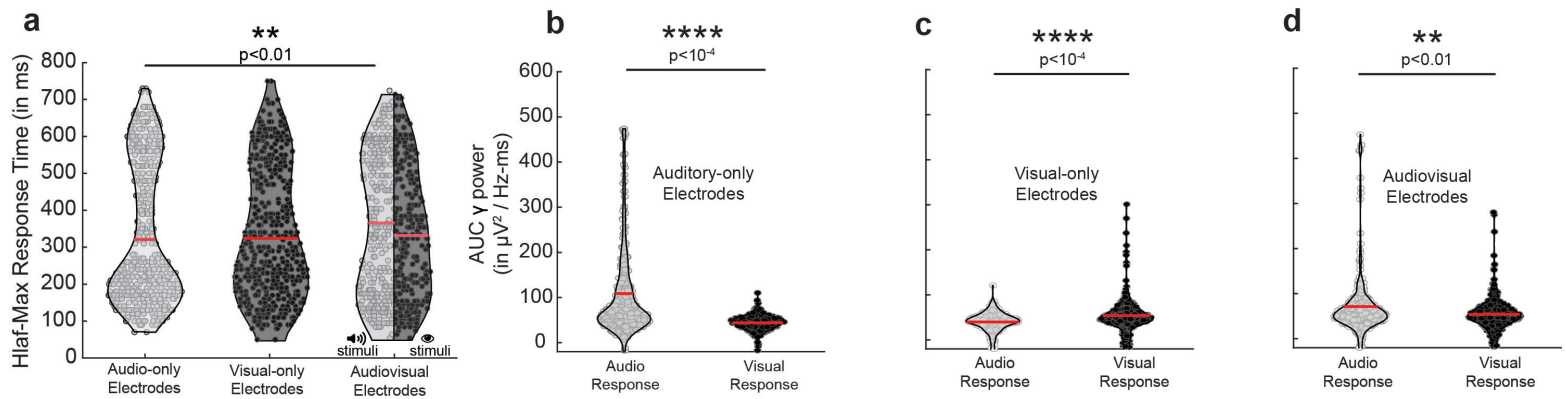


Fig. S2 | Half-maximum time and area under the curve for responsive electrodes. **a.** Half-maximum time for audio-only electrodes (left, light-gray: 329 ± 187 ms), visual-only electrodes (middle, black: 336 ± 174 ms), and audiovisual electrodes (right; auditory stimuli in light-gray: 379 ± 193 ms, visual stimuli in black: 341 ± 174 ms). There was a small but significant difference between the half-maximum time for auditory-only electrodes and for auditory responses of audiovisual electrodes ($p < 0.01$, ranksum test). Horizontal red bars indicate mean. Horizontal black bars indicate significant differences.

b-d. Area under the curve for the trial averaged response to auditory stimuli (light-gray violin plots) and visual stimuli (black violin plots) for audio-only electrodes (**b**, auditory stimuli: 108 ± 100 $\mu V^2 / \text{Hz} \cdot \text{ms}$, visual stimuli: 44 ± 16 $\mu V^2 / \text{Hz} \cdot \text{ms}$; $p < 10^{-4}$, ranksum test), visual-only electrodes (**c**, auditory stimuli: 40 ± 23 $\mu V^2 / \text{Hz} \cdot \text{ms}$, visual stimuli: 53 ± 43 $\mu V^2 / \text{Hz} \cdot \text{ms}$; $p < 10^{-4}$, ranksum test), and audiovisual electrodes (**d**, auditory stimuli: 71 ± 72 $\mu V^2 / \text{Hz} \cdot \text{ms}$, visual stimuli: 54 ± 39 $\mu V^2 / \text{Hz} \cdot \text{ms}$; $p < 0.01$, ranksum test). Horizontal red bars indicate mean. Horizontal black bars indicate significant differences.

FIGURE S3

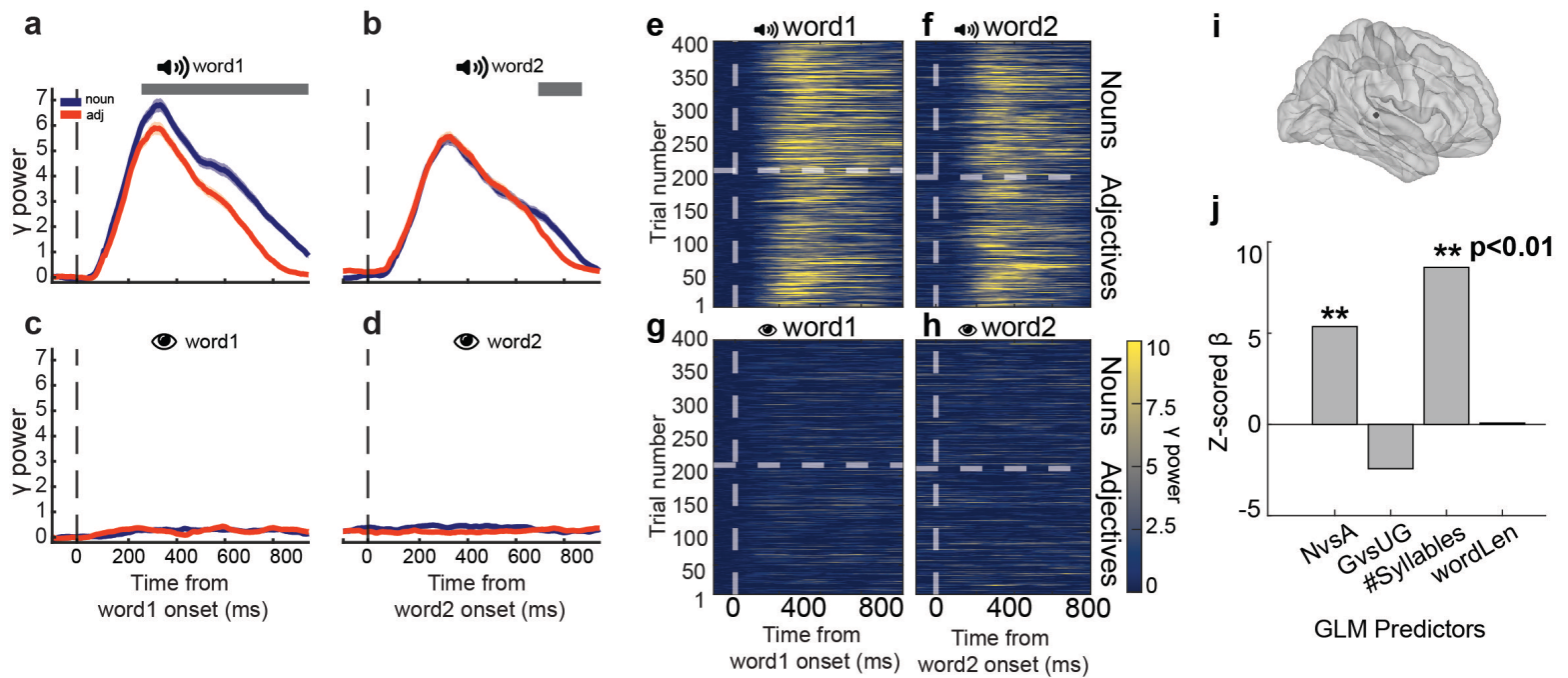


Fig. S3 | Example electrode distinguishing parts of speech only for auditory stimuli. a-d. Trial averaged γ -power of neural responses to Taiwanese words, separated by nouns (blue) and adjectives (red). Neural responses are shown for auditory presentation (**a**, **b**), and visual presentation (**c**, **d**), aligned to word1 onset (**a**, **c**) or word2 onset (**b**, **d**). The vertical dashed lines show word onsets. Shaded areas represent s.e.m. Horizontal lines indicate time periods of statistically significant differences between nouns and adjectives (t-test, $p < 0.05$, Benjamini-Hochberg false detection rate, $q < 0.05$). There was a significant differences between noun and adjectives for auditory presentations shown with a gray horizontal line but no difference for visual presentations.

e-h. Raster plots showing the responses in individual trials (see color scale on bottom right).

i. Electrode location in the right insula.

j. Z-scored β coefficients for Generalized Linear Model used to predict area under the curve between 200 ms and 800 ms post word onset using four task predictors: Noun versus Adjectives, Grammatically Correct versus Ungrammatical, number of syllables (auditory presentation) and word length (visual presentation). Asterisks denote statistically significant coefficients.

FIGURE S4

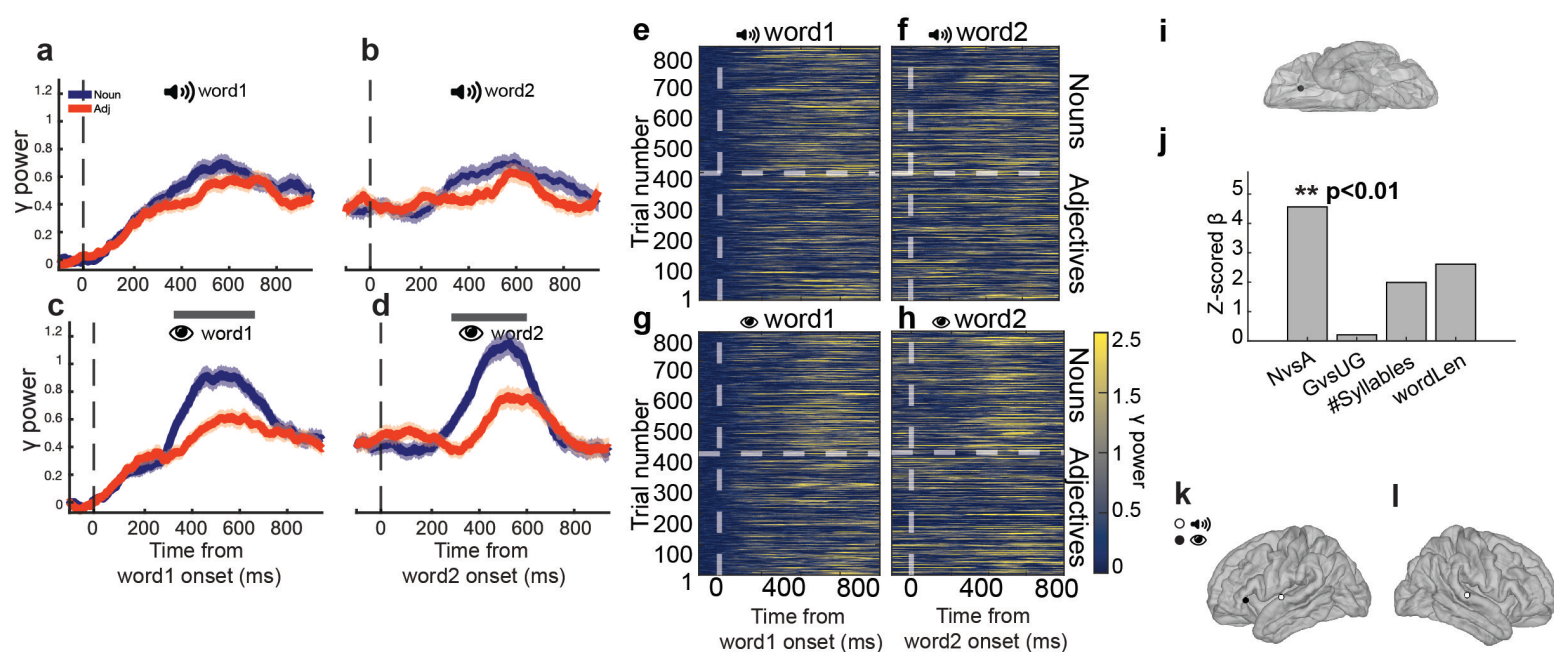


Fig. S4 | Example electrode distinguishing parts of speech only for visual stimuli. **a-d.** Trial averaged γ -power of neural responses to Taiwanese words, separated by nouns (blue) and adjectives (red). Neural responses are shown for auditory presentation (**a, b**), and visual presentation (**c, d**), aligned to word 1 onset (**a, c**) or word 2 onset (**b, d**). The vertical dashed lines show word onsets. Shaded areas represent s.e.m. Horizontal lines indicate time periods of statistically significant differences between nouns and adjectives (t-test, $p < 0.05$, Benjamini-Hochberg false detection rate, $q < 0.05$). There was a significant differences between noun and adjectives for visual presentations shown with a gray horizontal line but no difference for auditory presentations.

e-h. Raster plots showing the responses in individual trials (see color scale on bottom right).

i. Electrode location in the left lateral orbitofrontal.

j. Z-scored β coefficients for Generalized Linear Model used to predict area under the curve between 200 ms and 800 ms post word onset using four task predictors: Noun versus Adjectives, Grammatically Correct versus Ungrammatical, number of syllables (auditory presentation) and word length (visual presentation). Asterisks denote statistically significant coefficients.

k, l. Electrodes in the left (**k**) and right (**l**) hemispheres that showed significant differences between nouns and adjectives either only for auditory trials (white circles) or visual trials (black circles).

FIGURE S5

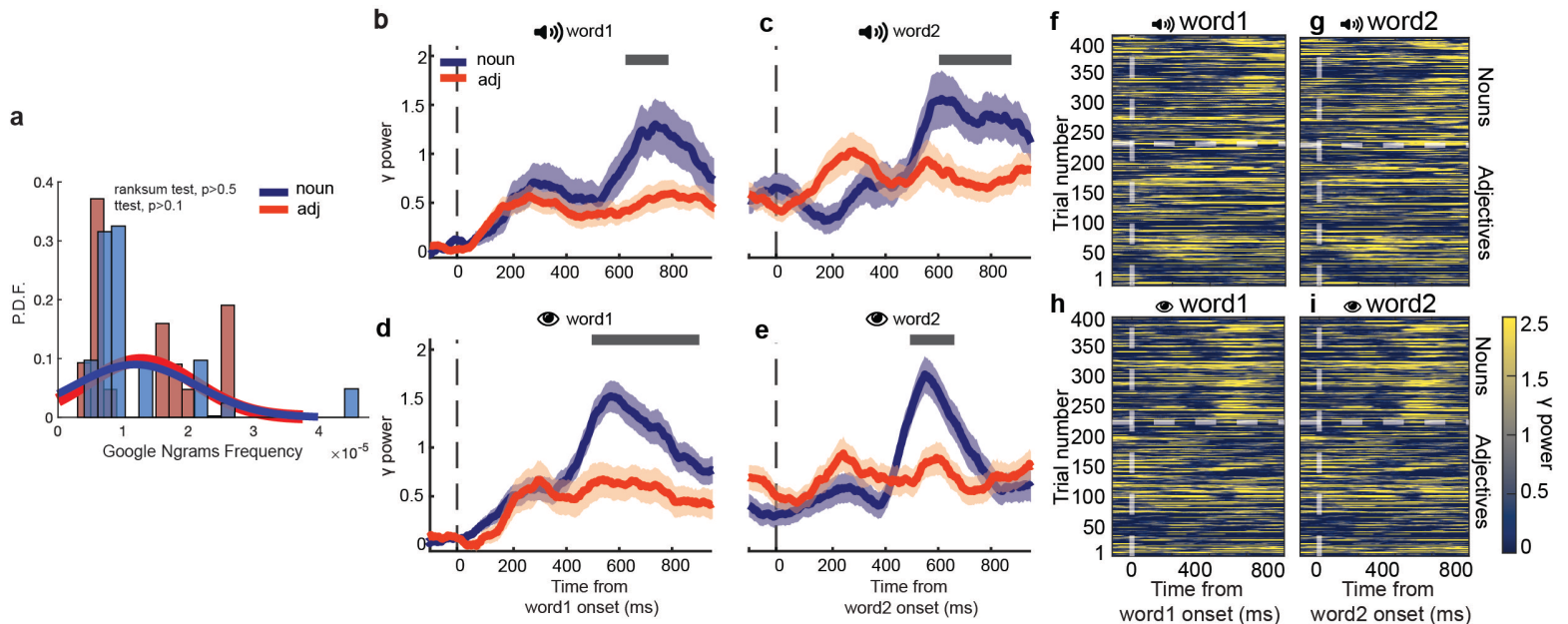


Fig. S5 | Example electrode distinguishes parts-of-speech for nouns and adjectives matched for their frequency of occurrence. **a.** Google Ngrams frequency distribution of nouns (blue) and adjectives (red) that were matched for their median ($p > 0.05$, ranksum test) and mean ($p > 0.05$, t-test).

b-e. Trial averaged γ -power of neural responses to word onsets, separated by nouns (blue) and adjectives (red). Neural responses are shown for auditory presentation (**b, c**), and visual presentation (**d, e**), aligned to word 1 onset (**a, c**) or word 2 onset (**c, e**). The vertical dashed lines show word onsets. Shaded areas represent s.e.m. Horizontal lines indicate time periods of statistically significant differences between noun subcategories and adjective subcategories (t-test, $p < 0.05$, Benjamini-Hochberg false detection rate, $q < 0.05$).

f-i. Raster plots showing the responses in individual trials (see color scale on bottom right).

FIGURE S6

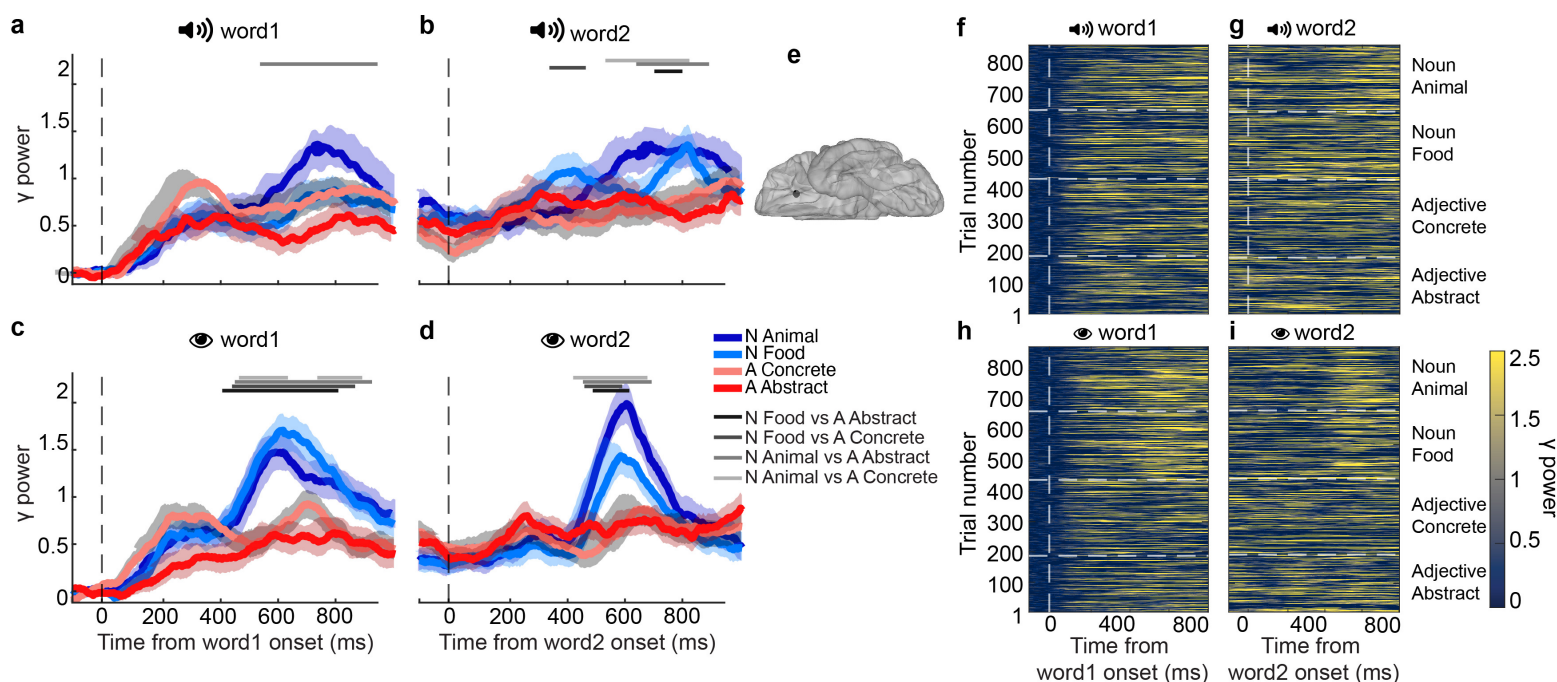


Fig. S6 | Selective responses to nouns versus adjectives across different noun and adjective categories. **a-d.** Trial averaged γ -power of neural responses to words, separated by animal nouns (dark blue), food nouns (light blue), concrete adjectives (light red), and abstract adjectives (dark red). Neural responses are shown for auditory presentation (**a**, **b**), and visual presentation (**c**, **d**), aligned to word 1 onset (**a**, **c**) or word 2 onset (**b**, **d**). The vertical dashed lines show word onsets. Shaded areas represent s.e.m. Horizontal lines indicate time periods of statistically significant differences between noun subcategories and adjective subcategories (t-test, $p < 0.05$, Benjamini-Hochberg false detection rate, $q < 0.05$). There were no significant differences between noun sub-categories or between adjective sub-categories.

e. Electrode location in left lateral orbitofrontal.

f-i. Raster plots showing the responses in individual trials (see color scale on bottom right).

FIGURE S7

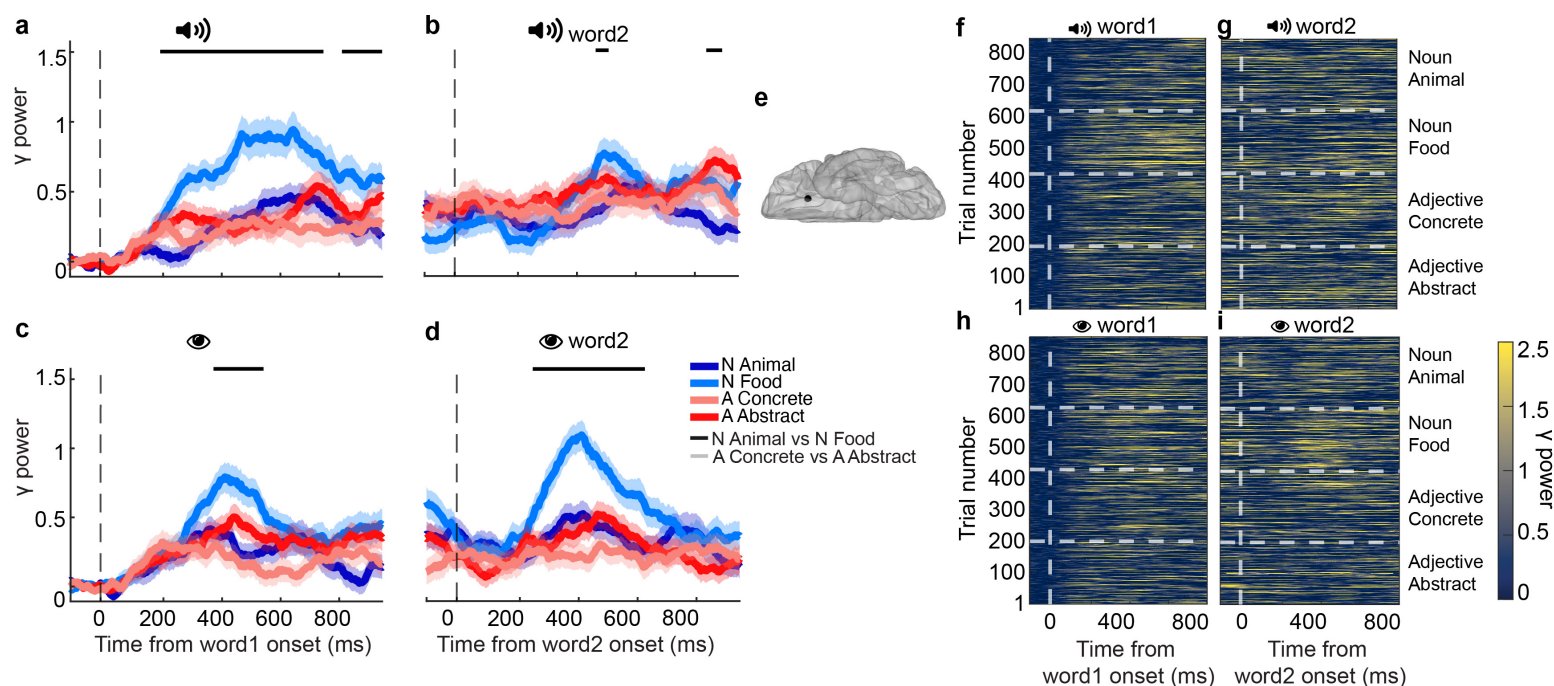


Fig. S7 | Example electrode distinguishing different types of nouns. **a-d.** Trial averaged γ -power of neural responses to words, separated by animal nouns (dark blue), food nouns (light blue), concrete adjectives (light red), and abstract adjectives (dark red). Neural responses are shown for auditory presentation (**a, b**), and visual presentation (**c, d**), aligned to word 1 onset (**a, c**) or word 2 onset (**b, d**). The vertical dashed lines show word onsets. Shaded areas represent s.e.m. Horizontal lines indicate time periods of statistically significant differences between noun subcategories and adjective subcategories (t-test, $p < 0.05$, Benjamini-Hochberg false detection rate, $q < 0.05$). There was a significant differences between noun sub-categories shown with a black horizontal line but no difference between adjective sub-categories.

e. Electrode location in the left lateral orbitofrontal.

f-i. Raster plots showing the responses in individual trials (see color scale on bottom right).

FIGURE S8

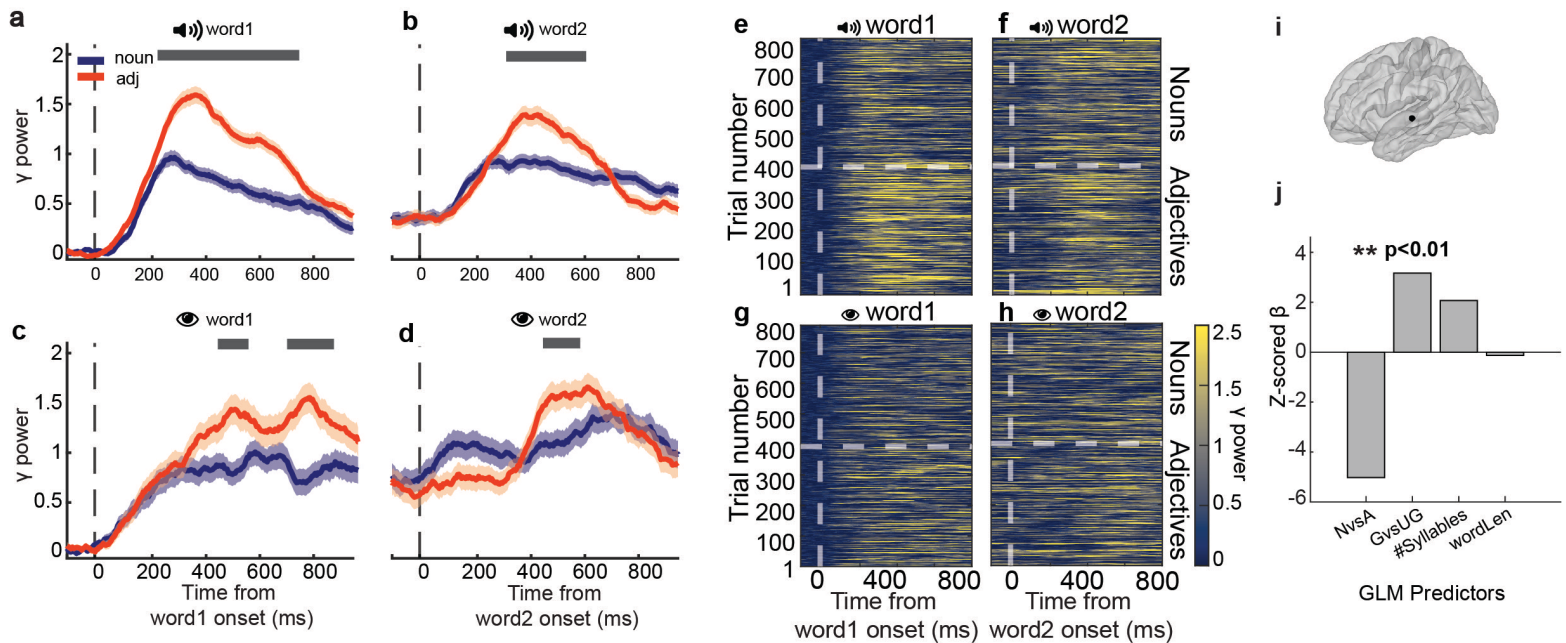


Fig. S8 | Example electrode distinguishing nouns from adjectives with a preference for adjectives. a-d. Trial averaged γ -power of neural responses to English words, separated by nouns (blue), and adjectives (red). Neural responses are shown for auditory presentation (a, b, , n=442 grammatical and 438 ungrammatical trials), and visual presentation (c, d, n=432 grammatical and 434 ungrammatical trials), aligned to word 1 onset (a, c) or word 2 onset (b, d). The vertical dashed lines show word onsets. Shaded areas represent s.e.m. Horizontal lines indicate time periods of statistically significant differences between nouns and adjectives (t-test, $p < 0.05$, Benjamini-Hochberg false detection rate, $q < 0.05$).

e-h. Raster plots showing the responses in individual trials (see color scale on bottom right).

i- Electrode location in the left superior temporal gyrus.

j-k. Z-scored β coefficients for Generalized Linear Model used to predict area under the curve between 200 ms and 800 ms post word using four task predictors: Noun versus Adjectives, Grammatical versus Ungrammatical, number of syllables (auditory presentation) and word length (visual presentation). Asterisks denote statistically significant coefficients. Only the Nouns vs Adjective task predictor was significant and showed a preference for adjectives ($p < 0.01$, corrected for multiple comparisons and $\beta_{NvsA} < 0$).

FIGURE S9

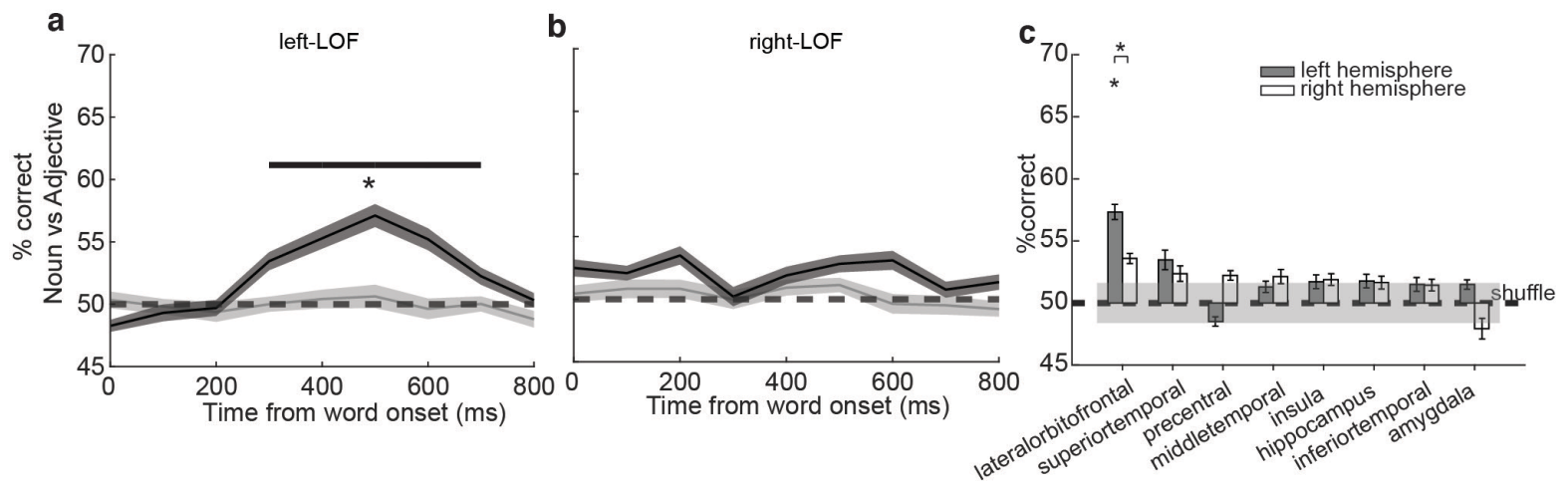


Fig. S9 | Neural signals from left-LOF distinguish nouns and adjectives when number of electrodes were normalized across all regions and both hemispheres. a-b. Average cross-validated performance of a support vector machine classifier (SVM, 80% training/20% test) decoding nouns versus adjectives for 8 randomly subsampled electrodes in the left lateral orbitofrontal cortex (LOF) (a), and in the right LOF (b).

Black: original labels; Gray: shuffled labels. The dotted horizontal black line shows the chance level. Solid horizontal gray bar shows time points where decoding from correct labels significantly differed from that of shuffled labels (100 random shuffles of the data, ranksum test, $p < 0.01$). The inputs to the SVM were 100 ms time bins from word onset containing the top-N principal components of the electrode response at each bin that explained $> 70\%$ variance for the training data (**Methods**).

c. Summary of average of max-decoding performance for distinguishing nouns versus adjectives across both hemispheres (left hemisphere: dark gray bars; right hemisphere: white bars) for different brain regions when a total of 8 electrodes was taken from each hemisphere in each region for the decoding. Regions with less than 8 electrodes in either hemisphere were omitted.

Asterisk: significant hemisphere within a Desikan-Killiani defined brain region ($p < 0.01$, ranksum test, corrected for multiple comparisons, and performance from the real and null distribution do not overlap within 3 standard deviations of each other) (**Methods**). Gray box: maximum mean $\pm$ s.t.d. for the null distribution across all regions. Asterisk with a U-bracket: significant difference between decoding accuracy of the left versus the right hemisphere ($p < 0.01$, ranksum test, corrected for multiple comparisons). Regions are sorted in descending order of performance in panel c.

FIGURE S10

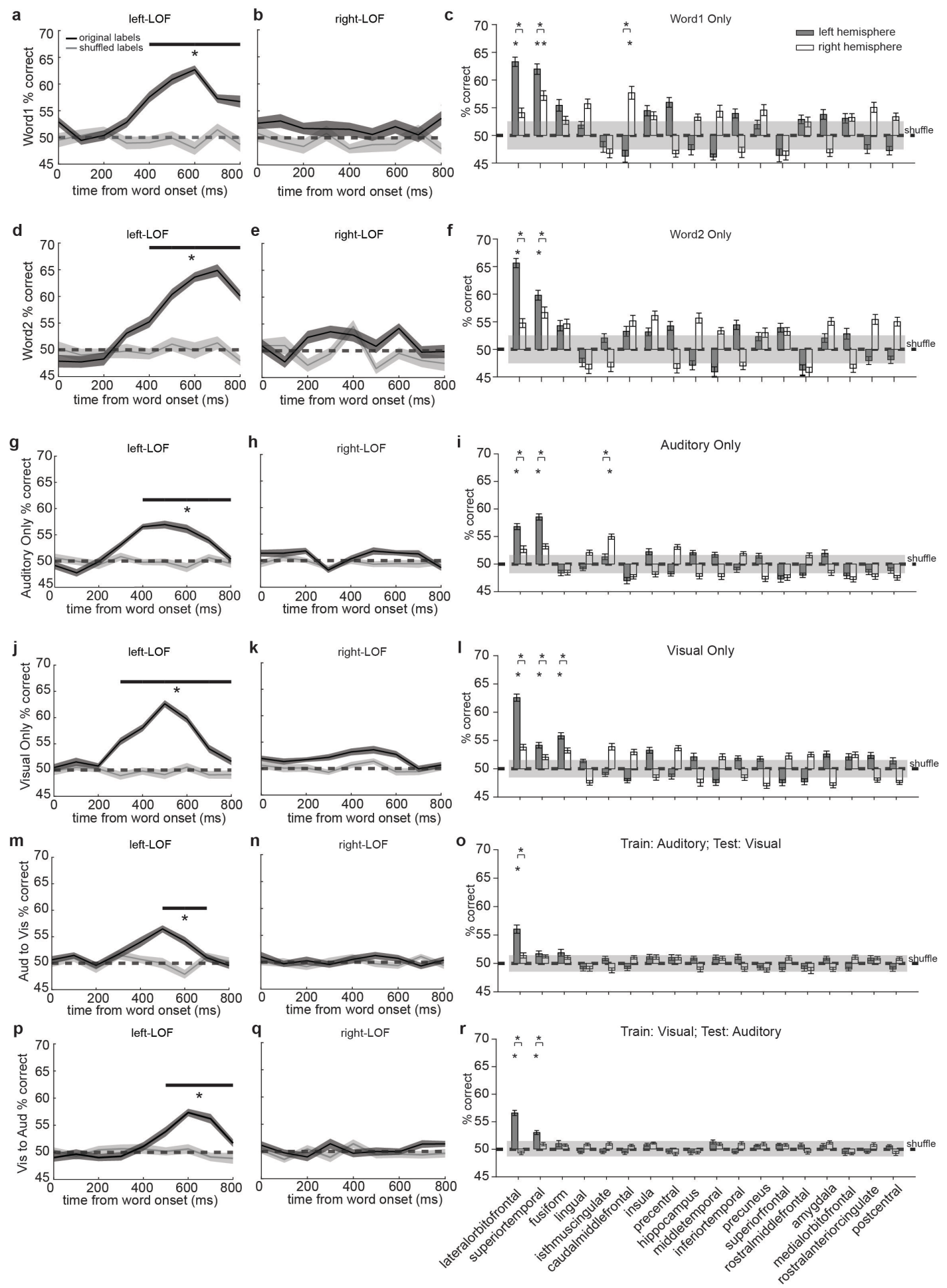


Fig. S10 | Neural signals distinguish nouns and adjectives in single trials for word1-only, word2-only, audio-only features, vision-only features, and generalization from audio to vision or vice versa.

a, b, d, e, g, h, m, n, p, q. Average cross-validated performance of a support vector machine classifier (SVM, 80% training/20% test) decoding nouns versus adjectives for all electrodes in the left lateral orbitofrontal cortex (LOF) (**a,d,g,j,m,p**), and in the right LOF (**b,e,h,k,n,q**). The dotted horizontal black line shows the chance level. Shaded areas denote s.e.m. Solid horizontal black bar shows time points where performance significantly differed from chance (100 random shuffles, ranksum test, $p < 0.01$). The inputs to the SVM included the top-N principal components of the electrode response that explained $>70\%$ variance for the training data at each time bin (**Methods**). Features from auditory and visual responses were combined and used for training and testing on datasets of word1 (**a,b**) and word2 trials (**d,e**). Using a combined dataset of word1 and word2 trials, the decoding performance was evaluated for audio-only (**g,h**) and vision-only features (**j,k**). The decoding performance generalized for audio to vision (**m,n**) and vice versa (**p,q**).

c, f, i, l, o, r . Summary of average of max-decoding performance for distinguishing nouns versus adjectives in each hemisphere (dark: left; white: right) for different brain regions. Bottom asterisks denote regions with significant decoding performance with respect to chance and performance from the real and null distribution do not overlap within 3 standard deviations of each other ($p < 0.01$, ranksum test, corrected for multiple comparisons, **Methods**). Shaded box: maximum of the mean $\pm$ SD. for the null distribution across all regions. Top asterisks with a U-bracket denote significant differences between decoding accuracy of the left versus the right hemisphere ($p < 0.01$, ranksum test, corrected for multiple comparisons). **c:** Classifiers were trained and tested on Word1 trials. **f:** Classifiers were trained and tested on Word2 trials. **i:** Classifiers were trained and tested on audio trials. **l:** Classifiers were trained and tested on visual trials. **o:** Classifiers were trained on audio trials and tested on visual trials. **r:** Classifiers were trained on visual trials and tested on audio trials.

FIGURE S11

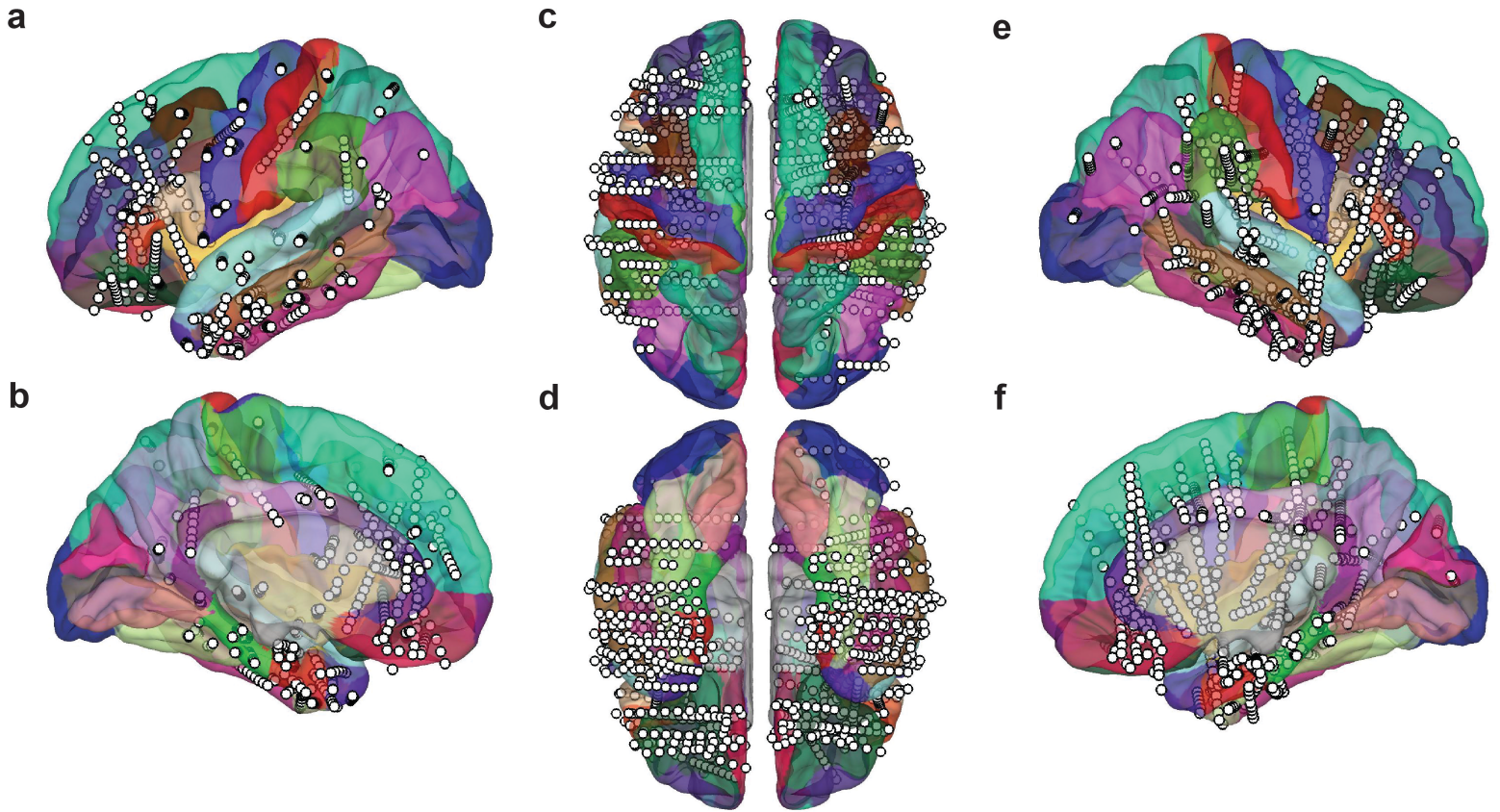


Fig. S11 | Electrode locations for sentence task

a-f. Location of all electrodes overlaid on the Desikan-Killiany Atlas shown with different views. Each white circle shows one electrode. **a.** Left lateral view (n=760), **b.** Left medial view (n=760), **c.** Superior, whole brain view (n=1593), **d.** Inferior, whole brain view (n= 1593), **e.** Right lateral view (n=833) **f.** Right medial view (n=833).

Subject	Age	Gender	Language	Handedness	#Trials	%Correct	#Electrodes
1	9	M	EN	R	1178	98.5	142
2	14	F	EN	R	1332	94.7	100
3	22	M	EN	R	1520	97.5	212
4	49	F	EN	L	760	83.3	44
5	18	F	EN	R	3573	99.6	100
6	20	M	EN	R	760	99.3	139
					760	67.5	
7	16	F	EN	L	760	97.9	88
8	12	F	EN	R	760	92.9	131
9	37	F	EN	R	1900	89.3	51
10	47	F	EN	R	1895	98.3	75
11	12	M	EN	R	950	95.5	135
12	13	F	EN	R	950	99.3	121
13	25	M	EN	L write, R throw	1520	99.3	84
14	26	F	EN	L write, R other	1900	97.4	32
15	32	F	EN	R	1521	98.4	29
					EN:950		
16	22	M	EN & SP	R	SP:950	97.3	77
17	42	M	TW	R	1068	89	57
18	36	M	TW	R	2429	87.1	59
19	53	F	EN	R	950	90.5	73
20	44	M	TW	R	1900	NA	52
TOTAL							1801

Table S1 | Information about each participant including age, gender, language (ENglish, SPanish, TaiWanese), handedness, number of trials, behavioral performance and number of electrodes.

Region\nelecs	Total	GMLeft	WMLeft	Left	GMRight	WMRight	Right	rAud	rVis	rAV
Amygdala	52	21	0	21	31	0	31	9	7	1
Cerebellum-Cortex	4	3	0	3	1	0	1	2	1	1
Hippocampus	59	33	0	33	26	0	26	15	14	5
Inf-Lat-Vent	1	1	0	1	0	0	0	0	1	0
Lateral-Ventricle	4	0	0	0	4	0	4	0	1	0
Putamen	2	1	0	1	1	0	1	1	0	0
VentralDC	1	1	0	1	0	0	0	0	0	0
bankssts	24	2	4	6	9	9	18	20	11	9
caudalanteriorcingulate	17	3	1	4	3	10	13	0	0	0
caudalmiddlefrontal	52	2	12	14	21	17	38	11	14	7
cuneus	16	0	3	3	10	3	13	6	8	5
entorhinal	6	1	1	2	2	2	4	0	1	0
frontalpole	1	0	0	0	1	0	1	1	1	1
fusiform	108	19	32	51	27	30	57	40	41	21
inferiorparietal	73	3	17	20	31	22	53	14	35	11
inferiortemporal	119	14	38	52	31	36	67	22	26	15
insula	109	18	29	47	29	33	62	45	24	12
isthmuscingulate	32	7	4	11	11	10	21	6	4	1
lateraloccipital	41	2	8	10	13	18	31	16	26	9
lateralorbitofrontal	113	7	31	38	38	37	75	45	40	29
lingual	45	6	13	19	8	18	26	21	33	17
medialorbitofrontal	47	10	8	18	14	15	29	6	9	5
middletemporal	117	27	39	66	24	27	51	28	20	8
paracentral	4	0	0	0	2	2	4	0	0	0
parahippocampal	27	12	4	16	6	5	11	3	3	1
parsopercularis	18	5	4	9	4	5	9	10	7	5
parsorbitalis	20	2	5	7	7	6	13	4	7	4
parstriangularis	34	3	4	7	16	11	27	9	10	7
pericalcarine	13	3	2	5	3	5	8	8	8	6
postcentral	37	2	6	8	10	19	29	13	12	7
posteriorcingulate	16	4	3	7	1	8	9	6	4	4
precentral	87	10	10	20	33	34	67	47	40	29
precuneus	80	12	24	36	14	30	44	6	15	3
rostralanteriorcingulate	16	3	4	7	5	4	9	0	0	0
rostralmiddlefrontal	94	16	22	38	24	32	56	27	28	18
superiorfrontal	85	17	16	33	19	33	52	18	18	9
superiorparietal	49	4	6	10	15	24	39	13	16	7
superiortemporal	108	20	38	58	15	35	50	69	28	26
supramarginal	56	0	0	0	30	26	56	15	12	5
temporalpole	4	3	1	4	0	0	0	1	2	0
transverse temporal	10	2	5	7	2	1	3	8	5	5
TOTAL	1801	299	394	693	541	567	1108	565	532	293

Table S2 | Distribution of electrodes over the Desikan-Killiany Atlas

The number of electrodes for different brain regions of the DK atlas (rows) for different conditions (columns). From the left to right the columns represent the following: (1) Total electrodes, (2) Gray Matter Left, (3) White Matter Left, (4) Total Left, (5) Gray Matter Right, (6) White Matter Right, (7) Total Right, (8) Responsive Audio, (9) Responsive Visual, (10) Responsive Audiovisual. The regions that showed a significant percent of audiovisual electrodes that was statistically unlikely to get from a random intersection of audio or visual electrodes are highlighted in bold ($p < 0.01$, permutation test, $n = 10^6$ iterations, total electrodes ≥ 20)

(a) ENGLISH

Noun Animal	Length	Syll.	Ngram Freq	Noun food	Length	Syll.	Ngram Freq
'fish'	4	1	6.42E-05	'water'	5	2	3.39E-04
'horse'	5	1	6.07E-05	'oil'	3	1	8.64E-05
'bear'	4	1	5.56E-05	'coffee'	6	2	3.94E-05
'dog'	3	1	5.33E-05	'salt'	4	1	3.70E-05
'bird'	4	1	3.20E-05	'fruit'	5	1	3.59E-05
'cat'	3	1	2.91E-05	'milk'	4	1	3.58E-05
'mouse'	5	1	2.31E-05	'sugar'	5	2	3.40E-05
'sheep'	5	1	1.95E-05	'tea'	3	1	3.33E-05
'turkey'	6	2	1.92E-05	'rice'	4	1	3.13E-05
'fox'	3	1	1.84E-05	'bread'	5	1	3.07E-05
'bull'	4	1	1.63E-05	'eggs'	4	1	2.13E-05
'rat'	3	1	1.49E-05	'corn'	4	1	2.00E-05
'wolf'	4	1	1.47E-05	'apple'	5	1	1.65E-05
'seal'	4	1	1.40E-05	'cheese'	6	1	1.53E-05
'lion'	4	2	1.36E-05	'butter'	6	2	1.51E-05
'deer'	4	1	1.24E-05	'pepper'	6	2	1.26E-05
'cow'	3	1	1.14E-05	'olive'	5	1	1.14E-05
'snake'	5	1	1.12E-05	'bean'	4	1	9.08E-06
'penguin'	7	2	1.05E-05	'garlic'	6	2	8.59E-06
'eagle'	5	2	9.73E-06	'salad'	5	2	8.55E-06
'dragon'	6	2	9.54E-06	'lemon'	5	2	8.49E-06
'pig'	3	1	9.35E-06	'onion'	5	2	6.42E-06
'bat'	3	1	9.28E-06	'berry'	5	1	6.39E-06
'tiger'	5	2	8.53E-06	'cherry'	6	1	6.27E-06
'rabbit'	6	2	8.41E-06	'pizza'	5	2	5.60E-06
'monkey'	6	2	6.86E-06	'nut'	3	1	5.20E-06
'duck'	4	1	6.70E-06	'pasta'	5	2	4.50E-06
'goat'	4	1	6.34E-06	'grape'	5	1	3.86E-06
'whale'	5	1	5.77E-06	'peas'	4	1	3.61E-06
'hawk'	4	1	5.56E-06	'peach'	5	1	3.22E-06
'spider'	6	2	5.46E-06	'plum'	4	1	2.78E-06
'ant'	3	1	5.33E-06	'lettuce'	7	2	2.68E-06
Adj concrete	Length	Syll.	Ngram Freq	Adj abstract	Length	Syll.	Ngram Freq
'long'	4	1	5.04E-04	'good'	4	1	5.76E-04
'small'	5	1	3.48E-04	'best'	4	1	2.69E-04
'large'	5	1	3.21E-04	'better'	6	2	2.63E-04
'low'	3	1	2.09E-04	'free'	4	1	2.17E-04
'short'	5	1	1.80E-04	'real'	4	1	2.10E-04
'clear'	5	1	1.74E-04	'poor'	4	1	1.42E-04
'hard'	4	1	1.59E-04	'bad'	3	1	1.09E-04
'strong'	6	1	1.47E-04	'serious'	7	2	8.12E-05
'big'	3	1	1.40E-04	'happy'	5	2	7.47E-05
'deep'	4	1	1.07E-04	'rich'	4	1	6.90E-05

'dark'	4	1	1.00E-04	'holy'	4	2	6.65E-05
'cold'	4	1	9.21E-05	'pretty'	6	2	5.84E-05
'round'	5	1	8.84E-05	'evil'	4	2	5.71E-05
'heavy'	5	2	6.79E-05	'wild'	4	1	5.37E-05
'hot'	3	1	6.75E-05	'pure'	4	1	4.79E-05
'fast'	4	1	6.44E-05	'sick'	4	1	3.45E-05
'dry'	3	1	5.33E-05	'busy'	4	2	2.96E-05
'soft'	4	1	5.22E-05	'sad'	3	1	2.54E-05
'slow'	4	1	4.84E-05	'proud'	5	1	2.53E-05
'solid'	5	2	4.74E-05	'calm'	4	1	2.47E-05
'huge'	4	1	4.71E-05	'gentle'	6	1	2.04E-05
'warm'	4	1	4.71E-05	'strict'	6	1	2.02E-05
'fat'	3	1	4.18E-05	'mad'	3	1	2.02E-05
'bright'	6	1	4.17E-05	'smart'	5	1	2.01E-05
'weak'	4	1	4.16E-05	'crazy'	5	2	1.70E-05
'thin'	4	1	4.10E-05	'brave'	5	1	1.55E-05
'sweet'	5	1	4.08E-05	'cheap'	5	1	1.49E-05
'silent'	6	1	3.65E-05	'ugly'	4	2	1.12E-05
'oval'	4	2	5.71E-06	'clever'	6	1	1.10E-05
'tiny'	4	2	2.93E-05	'jealous'	7	2	7.70E-06
'dirty'	5	2	1.58E-05	'shy'	3	1	7.70E-06
'massive'	7	2	2.52E-05	'lazy'	4	2	6.09E-06

(b) SPANISH

Noun Animal	Length	Syll.	Ngram Freq	Noun food	Length	Syll.	Ngram Freq
buho	4	2	6.00E-08	ajo	3	2	5.00E-06
burro	5	2	3.50E-06	arroz	5	2	1.30E-05
dragon	6	2	8.00E-08	café	4	2	5.00E-05
gallo	5	2	6.00E-06	coco	4	2	3.00E-06
gato	4	2	1.40E-05	frijol	6	2	4.50E-06
leon	4	1	2.20E-07	huevo	5	2	1.00E-05
lobo	4	2	7.80E-06	jamon	5	2	2.50E-08
mono	4	2	6.00E-06	jugo	4	2	5.90E-06
oso	3	2	4.80E-06	limon	5	2	6.40E-08
pato	4	2	2.50E-06	maiz	4	1	1.70E-06
pavo	4	2	3.00E-06	mango	5	2	4.50E-06
perro	5	2	3.70E-05	melon	5	2	3.00E-08
pez	3	1	8.00E-06	pan	3	1	3.70E-05
pulpo	5	2	1.00E-06	pastel	6	2	4.80E-06
raton	5	2	2.50E-08	postre	6	2	7.60E-06
tigre	5	2	5.00E-06	queso	5	2	1.10E-05
topo	4	2	1.60E-06	vino	4	2	8.00E-05
toro	4	2	9.30E-06	yogur	5	2	1.98E-06
Adj concrete	Length	Syll.	Ngram Freq	Adj abstract	Length	Syll.	Ngram Freq

alto	4	2	1.20E-04	bello	5	2	1.40E-05
ancho	5	2	2.50E-05	bueno	5	2	7.57E-05
bajo	4	2	2.88E-04	cruel	5	2	1.40E-05
claro	5	2	1.35E-04	feliz	5	2	4.84E-05
debil	5	2	1.20E-07	feo	3	2	5.56E-06
dulce	5	2	3.00E-05	guapo	5	2	7.44E-06
duro	4	2	3.30E-05	lindo	5	2	4.53E-06
fino	4	2	1.00E-05	listo	5	2	1.25E-05
frio	4	2	6.00E-07	loco	4	2	2.44E-05
fuerte	6	2	1.10E-05	malo	4	2	3.00E-05
grande	6	2	1.00E-04	pobre	5	2	5.00E-05
largo	5	2	2.22E-04	puro	4	2	2.50E-05
lento	5	2	1.70E-05	rico	4	2	2.32E-05
rojo	4	2	3.77E-05	sabio	5	2	1.38E-05
seco	4	2	1.80E-05	serio	5	2	3.96E-05
suave	5	1	3.00E-05	tonto	5	2	7.94E-06
sucio	5	2	6.78E-06	triste	5	2	3.36E-05
verde	5	2	3.78E-05	vago	4	2	5.00E-06

(c) TAIWANESE

Noun Animal	Length	Syll.	Ngram Freq	Noun food	Length	Syll.	Ngram Freq
乳牛-cow	2	2	1.00E-07	咖啡-coffee	2	2	4.60E-05
企鵝-penguin	2	2	1.40E-06	大蒜-garlic	2	2	8.00E-07
兔子-rabbit	2	2	3.30E-06	奶油-butter	2	2	7.60E-07
海豹-seal	2	2	5.10E-07	桃子-peach	2	2	4.60E-07
熊-bear	1	1	4.00E-06	水-water	1	1	2.00E-04
狐狸-fox	2	2	1.60E-06	沙拉-salad	2	2	3.80E-06
狗-dog	1	1	2.20E-05	洋蔥-onion	2	2	1.50E-06
狼-wolf	1	1	1.00E-05	牛奶-milk	1	1	7.80E-06
猴子-monkey	2	2	9.00E-06	玉米-corn	1	1	1.40E-05
獅子-lion	2	2	6.20E-06	米-rice	1	1	6.00E-05
綿羊-sheep	2	2	1.80E-06	糖-sugar	1	1	8.40E-06
老虎-tiger	2	2	7.00E-06	茶-tea	1	1	2.20E-05
老鼠-mouse	2	2	8.60E-06	葡萄-grape	2	2	3.70E-06
蜘蛛-spider	2	2	5.00E-06	蘋果-apple	2	2	2.30E-05
螞蟻-ant	2	2	4.60E-06	蛋-eggs	1	1	7.70E-06
貓-cat	1	1	9.10E-06	豆子-bean	2	2	4.70E-07
馬-horse	1	1	8.20E-05	辣椒-chili	2	2	9.00E-07
鯨魚-whale	2	2	1.80E-06	鳳梨-pineapp	2	2	4.50E-07
鳥-bird	1	1	1.30E-05	鹽-salt	1	1	1.20E-05
龍-dragon	1	1	2.00E-05	麵包-bread	2	2	2.50E-05
Adj concrete	Length	Syll.	Ngram Freq	Adj abstract	Length	Syll.	Ngram Freq
乾的-dry	2	2	1.00E-04	假的-fake	2	2	4.00E-05
低的-low	2	2	2.00E-04	傻的-silly	2	2	4.00E-06

冷的-cold	2	2	1.50E-05	壞的-bad	2	2	4.30E-05
大的-large	2	2	1.40E-03	好的-good	2	2	6.00E-04
小的-small	2	2	4.50E-04	帥的-handsor	2	2	2.50E-06
快的-fast	2	2	9.60E-05	忙的-busy	2	2	1.50E-05
慢的-slow	2	2	3.00E-05	怒的-angry	2	2	5.50E-06
濕的-wet	2	2	8.10E-06	懶的-lazy	2	2	3.80E-06
熱的-hot	2	2	5.50E-05	新的-new	2	2	1.40E-03
甜的-sweet	2	2	5.00E-06	病的-sick	2	2	4.30E-04
瘦的-thin	2	2	4.00E-06	瘋的-mad	2	2	4.50E-06
短的-short	2	2	5.00E-05	真的-real	2	2	1.40E-04
硬的-hard	2	2	2.00E-05	窮的-poor	2	2	1.80E-05
胖的-fat	2	2	6.30E-06	笨的-stupid	2	2	2.20E-06
軟的-soft	2	2	2.60E-05	累的-tired	2	2	1.70E-05
輕的-light	2	2	3.00E-05	美的-beautifu	2	2	2.00E-04
酸的-sour	2	2	3.80E-06	舊的-old	2	2	8.00E-05
重的-heavy	2	2	2.20E-04	貴的-expensi	2	2	2.70E-05
長的-long	2	2	3.00E-04	醜的-ugly	2	2	6.30E-06
高的-tall	2	2	5.00E-04	難的-difficult	2	2	1.40E-04

Table S3 | List of all the words used in the experiment, their lengths, number of syllables, and occurrence frequency. (a) English. (b) Spanish. (c) Taiwanese

Region	Total	Left	Right
hippocampus	1	1	0
fusiform	1	1	0
lateralorbitofrontal	10	9	1
superiortemporal	2	2	0
TOTAL	14	13	1

Table S4 | Distribution of electrodes that showed modulation by part of speech across brain regions. Significant regions showing lateralization shown in bold. ($p < 10^{-5}$, permutation test, $n = 10^6$ iterations, regions with less than 4 electrodes were excluded).

subject#	#Total	NounEnhanced ($\beta > 0$)	AdjEnhanced ($\beta < 0$)	Generalize	SubCategory (=Total- Generalized)
5	2	2	0	0	2
14	3	2	1	1	2
16	3	3	0	3	0
18	2	2	0	2	0
20	4	2	2	2	2
TOTAL	14	11	3	8	6

Table S5 | Distribution of nouns- versus adjective-preferring electrodes and electrodes that generalize for parts-of-speech versus those that do not.

Distribution across different subjects of electrodes that are more noun enhanced (column 3) versus more adjective enhanced (column 4), and that of electrodes that generalize to nouns and adjectives (column 5) versus those that showed differences between noun subcategories or adjective subcategories (column 6).

Region	RegionTotal	Noun	Adjective
hippocampus	1	1	0
fusiform	1	1	0
lateralorbitofrontal	10	9	1
superiortemporal	2	0	2
TOTAL	14	11	3

Table S6 | Distribution of nouns- versus adjective-preferring electrodes across brain regions. A permutation test combining all brain regions for these electrodes showed that that LOF was significantly noun preferring. ($p < 10^{-5}$, permutation test, $n = 10^6$ iterations, regions with less than 4 electrodes were excluded).

subject#	nLeftLOF	nPOS	%POS
6	6	0	0
9	3	0	0
13	6	0	0
14	4	3	75
15	4	0	0
16	5	3	60
18	5	2	40
20	5	2	40
Total	38	10	Mean%All = 27 ± 31
Mean%POSsubjects = 54 ± 17			

Table S7 | Distribution of part of speech encoding electrodes in the left lateralorbitofrontal cortex across subjects

Noun Animal	(#N+1)/ (#N+1)/					Noun food	(#N+1)/ (#N+1)/				
	#N	#A	#V	(#A+1)	(#V+1)		#N	#A	#V	(#A+1)	(#V+1)
'fish'	105	0	11	106.0	8.8	'water'	372	0	0	373	373
'horse'	126	0	0	127.0	127.0	'oil'	110	0	0	111	111
'bear'	11	0	93	12.0	0.1	'coffee'	68	0	0	69	69
'dog'	124	0	0	125.0	125.0	'salt'	33	0	0	34	34
'bird'	93	0	0	94.0	94.0	'fruit'	51	0	0	52	52
'cat'	55	0	0	56.0	56.0	'milk'	48	0	0	49	49
'mouse'	28	0	0	29.0	29.0	'sugar'	38	0	0	39	39
'sheep'	30	0	0	31.0	31.0	'tea'	88	0	0	89	89
'turkey'	0	0	0	-	-	'rice'	16	0	0	17	17
'fox'	13	0	0	14.0	14.0	'bread'	38	0	0	39	39
'bull'	12	0	0	13.0	13.0	'eggs'	62	0	0	63	63
'rat'	24	0	0	25.0	25.0	'corn'	12	0	0	13	13
'wolf'	12	0	0	13.0	13.0	'apple'	35	0	0	36	36
'seal'	15	0	15	16.0	1.0	'cheese'	30	0	0	31	31
'lion'	21	0	0	22.0	22.0	'butter'	21	0	0	22	22
'deer'	0	0	0	-	-	'pepper'	11	0	0	12	12
'cow'	26	0	0	27.0	27.0	'olive'	0	0	0	-	-
'snake'	12	0	0	13.0	13.0	'bean'	18	0	0	19	19
'penguin'	0	0	0	-	-	'garlic'	0	0	0	1	1
'eagle'	18	0	0	19.0	19.0	'salad'	14	0	0	15	15
'dragon'	13	0	0	14.0	14.0	'lemon'	14	0	0	15	15
'pig'	25	0	0	26.0	26.0	'onion'	12	0	0	13	13
'bat'	13	0	0	14.0	14.0	'berry'	0	0	0	-	-
'tiger'	13	0	0	14.0	14.0	'cherry'	0	0	0	-	-
'rabbit'	25	0	0	26.0	26.0	'pizza'	0	0	0	-	-
'monkey'	11	0	0	12.0	12.0	'nut'	15	0	0	16	16
'duck'	19	0	0	20.0	20.0	'pasta'	0	0	0	-	-
'goat'	12	0	0	13.0	13.0	'grape'	0	0	0	-	-
'whale'	13	0	0	14.0	14.0	'peas'	33	0	0	34	34
'hawk'	0	0	0	-	-	'peach'	0	0	0	-	-
'spider'	10	0	0	11.0	11.0	'plum'	0	0	0	-	-
'ant'	10	0	0	11.0	11.0	'lettuce'	0	0	0	-	-
Adj concrete	(#A+1)/ (#A+1)/					Adj abstract	(#A+1)/ (#A+1)/				
	#A	#N	#V	(#N+1)	(#V+1)		#A	#N	#V	(#N+1)	(#V+1)
'long'	392	0	0	393.0	393.0	'good'	1276	25	0	49.1	1277.0
'small'	518	0	0	519.0	519.0	'best'	0	0	0	-	-
'large'	471	0	0	472.0	472.0	'better'	0	0	0	-	-
'low'	286	0	0	287.0	287.0	'free'	200	0	23	201.0	8.4
'short'	198	0	0	199.0	199.0	'real'	227	0	0	228.0	228.0

'clear'	239	0	55	240.0	4.3	'poor'	166	0	0	167.0	167.0
'hard'	176	0	0	177.0	177.0	'bad'	264	0	0	265.0	265.0
'strong'	196	0	0	197.0	197.0	'serious'	124	0	0	125.0	125.0
'big'	338	0	0	339.0	339.0	'happy'	129	0	0	130.0	130.0
'deep'	97	0	0	98.0	98.0	'rich'	79	0	0	80.0	80.0
'dark'	104	31	0	3.3	105.0	'holy'	30	0	0	31.0	31.0
'cold'	103	25	0	4.0	104.0	'pretty'	30	0	0	31.0	31.0
'round'	28	47	0	0.6	29.0	'evil'	15	16	0	0.9	16.0
'heavy'	105	0	0	106.0	106.0	'wild'	55	0	0	56.0	56.0
'hot'	94	0	0	95.0	95.0	'pure'	36	0	0	37.0	37.0
'fast'	50	0	0	51.0	51.0	'sick'	44	0	0	45.0	45.0
'dry'	56	0	28	57.0	2.0	'busy'	53	0	0	54.0	54.0
'soft'	66	0	0	67.0	67.0	'sad'	36	0	0	37.0	37.0
'slow'	56	0	23	57.0	2.4	'proud'	32	0	0	33.0	33.0
'solid'	35	0	0	36.0	36.0	'calm'	14	0	0	15.0	15.0
'huge'	79	0	0	80.0	80.0	'gentle'	29	0	0	30.0	30.0
'warm'	70	0	0	71.0	71.0	'strict'	24	0	0	25.0	25.0
'fat'	20	28	0	0.7	21.0	'mad'	32	0	0	33.0	33.0
'bright'	62	0	0	63.0	63.0	'smart'	16	0	0	17.0	17.0
'weak'	45	0	0	46.0	46.0	'crazy'	18	0	0	19.0	19.0
'thin'	56	0	0	57.0	57.0	'brave'	18	0	0	19.0	19.0
'sweet'	36	0	0	37.0	37.0	'cheap'	68	0	0	69.0	69.0
'silent'	38	0	0	39.0	39.0	'ugly'	14	0	0	15.0	15.0
'oval'	0	0	0	-	-	'clever'	25	0	0	26.0	26.0
'tiny'	56	0	0	57.0	57.0	'jealous'	0	0	0	-	-
'dirty'	27	0	0	28.0	28.0	'shy'	11	0	0	12.0	12.0
'massive'	44	0	0	45.0	45.0	'lazy'	0	0	0	-	-

Table S8 | List of all the words used in the experiment, the number of times they occurred in the British National Corpus as a noun (#N), as an adjective (#A), or a verb (#V), and the ratios of their frequency of occurrence in their assigned part of speech versus their usage in other parts of speech. Dashes indicate words that were missing in the corpus.

Subject	Age	Gender	Language	Handedness	#Trials	%Correct	#Electrodes
1	13	M	HI	R	786	54%	134
2	15	F	TW	R	627	69%	35
3	19	M	EN	R	587	96%	174
4	37	F	EN	R	603	97%	78
5	40	M	EN	R	604	99%	73
6	21	M	TW	L	621	71%	64
7	30	M	TW	R	625	59%	78
8	42	F	EN	R	601	87%	154
9	27	F	EN	R	589	96%	62
10	32	F	EN	R	600	92%	141
11	20	F	EN	L	600	96%	72
12	25	M	EN	L	597	77%	92
13	33	F	EN	R	594	96%	65
14	50	F	EN	R	588	96%	117
15	20	M	EN	R	578	94%	65
16	20	F	EN	R	604	84%	81
17	20	F	EN	R	600	94%	78
TOTAL							1563

Table S9 | Information about each participant for the sentence task including age, gender, language (ENglish, HIndi, TaiWanese), handedness, number of trials, behavioral performance and number of electrodes.

(a) English

Semantically Correct

W1	W2	W3	W4	W1	W2	W3	W4
the	boys	caught	balls	the	girls	opened	cans
the	girls	ate	pies	the	women	wrote	poems
the	kids	drank	milk	the	men	read	stories
the	men	cut	cakes	the	dogs	wagged	tails
the	girls	read	books	the	men	posted	letters
the	cows	ate	grass	the	kids	locked	doors
the	bees	flapped	wings	the	kids	played	dice
the	horse	ate	grass	the	boys	grew	plants
the	kids	broke	plates	the	guard	held	guns
the	boys	played	soccer	the	dogs	shed	hair
the	girls	played	hockey	the	banker	loaned	money
the	men	ate	bread	the	kids	spilled	water
the	women	plucked	fruits	the	women	cleaned	rooms
the	men	tried	shirts	the	women	played	songs
the	dogs	bit	shoes	the	boys	made	noises
the	birds	laid	eggs	the	friend	ran	races
the	snake	ate	eggs	the	ants	carried	leaves
the	cows	gave	milk	the	horse	made	sounds
the	chefs	made	pizza	the	people	loved	books
the	kids	played	music	the	kids	closed	doors
the	girls	baked	cakes	the	sister	boarded	planes
the	kids	broke	windows	the	teacher	handed	papers
the	boys	poured	water	the	artists	painted	trees
the	girls	dug	holes	the	student	raised	questions
the	girls	fried	eggs	the	grand	grew	chickens
the	men	kicked	balls	the	uncle	planted	seeds
the	boys	heard	music	the	father	paid	bills
the	men	rode	bikes	the	mother	raised	babies
the	kids	rang	bells	the	fairies	gave	gifts
the	women	stored	food	the	girls	played	guitar
the	girls	carried	books	the	grand	grew	lettuce
the	girls	stored	money	the	teacher	answered	questions
the	boys	watched	movies	the	mother	folded	clothes
the	mom	baked	cakes	the	thief	stole	food
the	birds	ate	seeds	the	men	moved	chairs
the	cats	drank	milk	the	rocks	broke	windows
the	men	sipped	wine	the	monk	showed	teeth
the	kids	cleaned	tables	the	chefs	cracked	eggs
the	kids	wore	hats	the	boys	pushed	rocks
the	boys	wore	pants	the	girls	finished	homework
the	women	boiled	eggs	the	student	wrote	notes
the	men	clicked	pictures	the	friend	grasped	hands
the	men	chopped	trees	the	player	headed	balls
the	boys	wrote	letters	the	teacher	helped	students
the	girls	drove	cars	the	kids	enjoyed	parties
the	dogs	fetched	bones	the	sales	knocked	doors
the	bears	ate	honey	the	men	loaded	trucks
the	dogs	drank	milk	the	women	loved	shoes
the	cats	climbed	trees	the	women	ordered	dinner
the	ducks	laid	eggs	the	men	placed	bets
the	monk	stole	mangoes	the	girls	ran	races
the	robber	stole	money	the	parent	scolded	children
the	cloud	brought	rain	the	girls	smelled	flowers
the	girls	cut	pizza	the	soldier	spread	flags
the	girls	wrote	stories	the	women	tried	shoes
the	boys	read	books	the	grand	taught	lessons
the	men	built	walls	the	chefs	toasted	bread
the	girls	drove	trucks	the	monk	grabbed	branches
the	girls	rode	bikes	the	tourist	tossed	coins
the	women	sipped	tea	the	parrot	used	tools
the	guard	kept	guns	the	girls	untied	knots
the	kids	wore	masks	the	girls	wanted	icecream
the	boys	watched	soccer	the	women	warm	food
the	girls	watched	baseball	the	women	washed	clothes
the	women	watched	movies	the	champion	won	games
the	horse	drank	milk	the	shopper	wrapped	presents
the	kids	wore	shirts	the	dogs	watched	trees
the	boys	carried	rocks	the	cats	chased	laser
the	boys	broke	eggs	the	teacher	spelled	words
the	women	bought	clothes	the	dragon	spat	fire
the	girls	bought	fruits	the	girls	flicked	pages
the	boys	bought	food	the	turtle	ate	food
the	birds	made	nests	the	kids	carried	backpacks
the	birds	hid	eggs	the	men	sang	songs
the	boys	threw	stones	the	boys	opened	doors
the	girls	played	basketball				

Semantically Incorrect/Odd

W1	W2	W3	W4	W1	W2	W3	W4
the	balls	caught	boys	the	cans	opened	girls
the	pies	ate	girls	the	poem	wrote	women
the	milk	drank	kids	the	stories	read	men
the	cakes	cut	men	the	tails	wagged	dogs
the	books	read	girls	the	letters	posted	men
the	grass	ate	cows	the	doors	locked	kids
the	wings	flapped	bees	the	dice	played	kids
the	grass	ate	horses	the	plants	grew	boys
the	plates	broke	kids	the	guns	held	guards
the	soccer	played	boys	the	hair	shed	dogs
the	hockey	played	girls	the	money	loaned	bankers
the	bread	ate	men	the	kids	spilled	kids
the	fruits	plucked	women	the	rooms	cleaned	women
the	shirts	tried	men	the	songs	played	women
the	shoes	bit	dogs	the	noises	made	boys
the	eggs	laid	birds	the	races	ran	friends
the	eggs	ate	snakes	the	ants	carried	ants
the	milk	gave	cows	the	horses	made	horses
the	pizza	made	chefs	the	books	loved	people
the	music	played	kids	the	doors	closed	kids
the	cakes	baked	girls	the	plane	boarded	sisters
the	window	broke	kids	the	paper	handed	teachers
the	water	poured	boys	the	trees	painted	artists
the	holes	dug	girls	the	questions	raised	students
the	eggs	fried	girls	the	chicken	grew	grandmas
the	balls	kicked	men	the	seeds	planted	uncles
the	music	heard	boys	the	bills	paid	fathers
the	bikes	rode	men	the	babies	raised	mothers
the	bells	rang	kids	the	gifts	gave	fairies
the	food	stored	women	the	guitar	played	girls
the	books	carried	girls	the	lettuce	grew	grandmas
the	money	stored	girls	the	questions	answered	teachers
the	movie	watched	boys	the	clothes	folded	mothers
the	cakes	baked	mothers	the	food	stole	thieves
the	seeds	ate	birds	the	chairs	moved	men
the	milk	drank	cats	the	windows	broke	rocks
the	wine	sipped	men	the	teeth	showed	monkeys
the	tables	cleaned	kids	the	eggs	cracked	chefs
the	hats	wore	kids	the	boys	pushed	boys
the	pants	wore	boys	the	girls	finished	girls
the	eggs	boiled	women	the	notes	wrote	students
the	picture	clicked	men	the	hands	grasped	friends
the	trees	chopped	men	the	balls	headed	players
the	letters	wrote	boys	the	teacher	helped	teachers
the	cars	drove	girls	the	kids	enjoyed	kids
the	bones	fetched	dogs	the	doors	knocked	salesmen
the	honey	ate	bears	the	men	loaded	men
the	milk	drank	dogs	the	women	loved	women
the	trees	climbed	cats	the	dinner	ordered	women
the	eggs	laid	ducks	the	bets	placed	men
the	mango	stole	monkeys	the	races	ran	girls
the	money	stole	robbers	the	children	scolded	parents
the	rain	brought	clouds	the	flowers	smelled	girls
the	pizza	cut	girls	the	flags	spread	soldiers
the	stories	wrote	girls	the	shoes	tried	women
the	books	read	boys	the	grand	taught	grandpas
the	walls	built	men	the	bread	toasted	chefs
the	trucks	drove	girls	the	branches	grabbed	monkeys
the	bikes	rode	girls	the	tourists	tossed	tourists
the	tea	sipped	women	the	parrots	used	parrots
the	guns	kept	guards	the	girls	untied	girls
the	mask	wore	kids	the	icecream	wanted	girls
the	soccer	watched	boys	the	food	warm	women
the	baseball	watched	girls	the	clothes	washed	women
the	movie	watched	women	the	champion	won	champion
the	milk	drank	horses	the	shoppers	wrapped	shoppers
the	shirts	wore	kids	the	dogs	watched	dogs
the	rocks	carried	boys	the	cats	chased	cats
the	eggs	broke	boys	the	words	spelled	teachers
the	clothes	bought	women	the	fire	spat	dragons
the	fruits	bought	girls	the	pages	flicked	girls
the	food	bought	boys	the	food	ate	turtles
the	nests	made	birds	the	kids	carried	kids
the	eggs	hid	birds	the	men	sang	men
the	stone	threw	boys	the	doors	opened	boys
the	baske	played	girls				

(b) Taiwanese

Semantically Correct

W1	W2	W3	W4	Translation
男孩	正在	接	球	the boys are catching balls
女孩	正在	吃	派	the girls are eating pies

Semantically Incorrect/Odd

W1	W2	W3	W4
球	正在	接	男孩
派	正在	吃	女孩

बचचो	न	फालेम	देखी	the young	Girl	watched	the film
बालेल	न	डरस	फाडो	the cat	tore	the dress	
टांचर	न	कवात	लाखी	the teacher	wrote	the poem	
दादो	न	साडी	पहनी	sister	wore	the saree	
दादो	न	खोर	बनाय	grandma	made	the kheer	
रानी	न	चाय	पो	the queen	drank	tea	
लडको	न	शरट	सोलो	the girl	stitched	the shirt	
भाल	न	शहद	खाया	the bear	ate	the honev	
आदम	न	आल	बचा	the man	sold	the potato	
भाई	न	कदद	काटा	brother	cut	the pumpkin	
बदर	न	शोर	कायो	the monkey	made	noise	
बदर	न	फल	तांडा	the monkey	plucked	the flower	
जानव	न	दध	पोया	the animal	drank	milk	
गारड	न	गेट	खाला	the guard	opened	the gate	
लडको	न	फालेम	बनाय	the girl	made	the film	
बचचो	न	गद	फको	the young	Girl	threw	the ball
लडको	न	गाडो	चलाय	the girl	drove	the car	
हाथो	न	पंड	तांडा	the elephant	broke	the tree	
मालो	न	पंड	तांडा	the gardner	cut	the tree	
मालो	न	पानो	डाला	the gardner	gave	water (to the gar	
आदम	न	गाना	गया	the man	sang	the song	
दादो	न	गाना	बजाय	grandpa	played	the song	
आदम	न	सातार	बजाय	the man	played	sitar	
बालेल	न	आवाज	लगाय	the cat	made	the call (meow)	
दादो	न	दवा	दो	grandma	gave	medicine	
डक्टर	न	डलाज	करा	the doctor	did	the treatment	
नारो	न	पढाई	करो	the woman	did	the studv	
बालेल	न	घटो	बजाय	the cat	rang	the bell	
दादो	न	खोडक	खोलो	grandma	opened	the window	
भाल	न	गडडा	खादो	the bear	dug	the hole	
लडको	न	टरक	चलाय	the girl	drove	the truck	
शर	न	आराम	करा	the lion	did	rest (noun)	
बचचो	न	हाको	खेलो	the young	Girl	plaved	hockey
आदम	न	जता	पहना	the man	wore	the shoe	
बाबा	न	सट	पहना	old-man	wore	a suit	
लडको	न	चटनी	खाड	the girl	ate	the chutnev	
लडको	न	फोटो	खीचो	the girl	clicked	the photograph	
दादो	न	घडो	पहनी	grandma	wore	the watch	
शरनो	न	चाय	पो	the lioness	drank	tea	
बकरो	न	शराब	पो	the goat	drank	wine	
लडको	न	चाय	पो	the girl	drank	tea	
लडको	न	खोर	खाड	the girl	ate	the pudding	
बकरो	न	रोटो	खाड	the goat	ate	bread	
घाडो	न	आवाज	करो	the horse	made	sound (neigh)	
भाल	न	फल	खाया	the bear	ate	the fruit	
बदर	न	आम	चसा	the monkey	sucked	a mango	
बकरो	न	घास	चबाड	the goat	chewed	grass	
बकरो	न	जोभ	दाखार	the goat	showed	the tougue	
घाडो	न	जोभ	दाखार	the horse	showed	the tongue	
बचचो	न	जोभ	दाखार	the young	Girl	showed	the tongue
बदर	न	आम	तांडा	the monkey	plucked	the mango	
बचचो	को	चाट	लगी	the young	Girl	got	hurt
बालेल	को	ठड	लगी	the cat	felt	the cold	
नारो	को	गरमी	लगी	the woman	felt	the heat	
बचचो	न	नाव	चलाय	the young	Girl	rowed	the boat
लडको	न	बदक	चलाय	the girl	operated	the gun	
आदम	न	पानो	डाला	the man	put	water (on the plants)	
आदम	न	कक	बनाय	the man	made	the cake	
आदम	न	मासक	पहना	the man	wore	a mask	
आदम	न	फोन	कायो	the man	dialed	the phone	
आदम	न	अखबा	पढा	the man	read	the newspaper	
आदम	न	खत	पढा	the man	read	the letter	
आदम	न	खत	लाखी	the man	wrote	the letter	
नरस	न	जोभ	देखी	the nurse	checked	the tongue	
नरस	न	दवा	दो	the nurse	gave	the medicine	
लडको	न	दवा	खाड	the girl	ate	the medicine	
बाबा	न	जस	पोया	the old	Man	drank	the iuice
बदर	न	जस	पोया	the monkey	drank	the iuice	
भाल	न	जस	पोया	the bear	drank	the iuice	
बदर	न	दध	पोया	the monkey	drank	the milk	
नारो	न	खोर	बनाय	the woman	made	the pudding	
नारो	न	सबजो	बनाय	the woman	made	the vegetableCu	
नारो	न	आग	लगाय	the woman	put	the fire	
नारो	न	आग	बझाय	the woman	extinguished	the fire	
नारो	न	रोटो	खाड	the woman	ate	bread	
नारो	न	डरस	पहनी	the woman	wore	the dress	
नरस	न	जान	बचाय	the nurse	saved	life	
लडको	न	पढाई	करो	the girl	did	the studv	
आदम	न	पहाड	चढा	the man	climbed	the hill	
लामडो	न	गद	फको	the fox	threw	the ball	
लामडो	न	बरड	खाड	the fox	ate	the bread	
आदम	न	शाशा	तांडा	the man	broke	the windowGlass	
सचोन	को	डेनाम	दोया	the player	got	the prize	
बततर	न	डबको	मारो	the duck	took	the dip	
लडको	न	डबको	मारो	the girl	took	the dip	

फालेम	न	बचचो	देखी
डरस	न	बालेल	फाडो
कवात	न	टांचर	लाखी
साडी	न	दादो	पहनी
खोर	न	दादो	बनायो
चाय	न	रानी	पो
शरट	न	लडको	सोलो
शहद	न	भाल	खाया
आल	न	आदमो	बचा
कदद	न	भाई	काटा
शोर	न	बदर	कायो
फल	न	बदर	तांडा
दध	न	जानव	पोया
गेट	न	गारड	खाला
फालेम	न	लडको	बनायो
गद	न	बचचो	फको
गाडो	न	लडको	चलायो
पंड	न	हाथो	तांडा
पंड	न	मालो	तांडा
पानो	न	मालो	डाला
गाना	न	आदमो	गया
गाना	न	दादो	बजाया
सातार	न	आदमो	बजाया
आवाज	न	बालेल	लगायो
दवा	न	दादो	दो
डलाज	न	डक्टर	करा
पढाई	न	नारो	करो
घटो	न	बालेल	बजायो
खोडक	न	दादो	खोलो
गडडा	न	भाल	खादो
टरक	न	लडको	चलायो
आराम	न	शर	करा
हाको	न	बचचो	खेलो
जता	न	आदमो	पहना
सट	न	बाबा	पहना
चटनी	न	लडको	खाड
फोटो	न	लडको	खीचो
घडो	न	दादो	पहनी
चाय	न	शरनो	पो
शराब	न	बकरो	पो
चाय	न	लडको	पो
खोर	न	लडको	खाड
रोटो	न	बकरो	खाड
आवाज	न	घाडो	करो
फल	न	भाल	खाया
आम	न	बदर	चसा
घास	न	बकरो	चबाड
जोभ	न	बकरो	दाखायो
जोभ	न	घाडो	दाखायो
जोभ	न	बचचो	दाखायो
आम	न	बदर	तांडा
चाट	को	बचचो	लगी
ठड	को	बालेल	लगी
गरमी	को	नारो	लगी
नाव	न	बचचो	चलायो
बदक	न	लडको	चलायो
पानो	न	आदमो	डाला
कक	न	आदमो	बनाया
मासक	न	आदमो	पहना
फोन	न	आदमो	कायो
अखबा	न	आदमो	पढा
खत	न	आदमो	पढा
खत	न	आदमो	लाखी
जोभ	न	नरस	देखी
दवा	न	नरस	दो
दवा	न	लडको	खाड
जस	न	बाबा	पोया
जस	न	बदर	पोया
जस	न	भाल	पोया
दध	न	बदर	पोया
खोर	न	नारो	बनायो
सबजो	न	नारो	बनायो
आग	न	नारो	लगायो
आग	न	नारो	बझायो
रोटो	न	नारो	खाड
डरस	न	नारो	पहनी
जान	न	नरस	बचायो
पढाई	न	लडको	करो
पहाड	न	आदमो	चढा
गद	न	लामडो	फको
बरड	न	लामडो	खाड
शाशा	न	आदमो	तांडा
डेनाम	को	सचोन	दोया
डबको	न	बततर	मारो
डबको	न	लडको	मारो

लडकी न	आख मारी	the girl winked the eve	आख न	लडकी मारी
बोलले न	आख मारी	the cat winked the eve	आख न	बोलले मारी
नारी न	गससा कोया	the woman made anger	गससा न	नारी कोया
आदम न	गससा कोया	the man made anger	गससा न	आदमी कोया
आदम न	सब खाया	the man ate the apple	सब न	आदमी खाया
टीचर न	सवाल पूछा	the teacher asked the question	सवाल न	टीचर पूछा
स्टुडेंट न	जवाब दया	the student answered the question	जवाब न	स्टुडेंट दया
नरस न	दवा लगाय	the nurse applied the medicine	दवा न	नरस लगाया
नरस न	इलाज करा	the nurse did the treatment	इलाज न	नरस करा
नरस न	सई लगाय	the nurse gave the injection	सई न	नरस लगाया
लडकी न	फटबा खेला	the girl played soccer	फटबा न	लडकी खेला
आदम न	कराक खेला	the man played cricket	कराक न	आदमी खेला
बदर न	कराक खेला	the monkey played cricket	कराक न	बदर खेला
बदर न	इनाम जीता	the monkey won the prize	इनाम न	बदर जीता
शर न	पहाड चढा	the lion climbed the hill	पहाड न	शर चढा
बदर न	पंड चढा	the monkey climbed the tree	पंड न	बदर चढा
बदर न	मासक पहना	the monkey wore the mask	मासक न	बदर पहना
बदर न	फोन कोया	the monkey called the phone	फोन न	बदर कोया
लडकी न	पलेट तोडा	the girl broke the plate	पलेट न	लडकी तोडा
लडकी न	खोडक तोडा	the girl broke the window	खोडक न	लडकी तोडा
लडकी न	गलती करा	the girl made the mistake	गलती न	लडकी करा
टीचर न	डाट लगाय	the teacher gave the scolding	डाट न	टीचर लगाया
बचचो न	खोर खाड	the young girl ate the pudding	खोर न	बचचो खाड
बदर न	सट पहना	the monkey wore the suit	सट न	बदर पहना
बदर न	गालार पकडा	the monkey held the glass	गालार न	बदर पकडा
भाल न	गालार पकडा	the bear held the glass	गालार न	भाल पकडा
भाल न	दध पोया	the bear drank the milk	दध न	भाल पोया
बकरी न	टोपी पहनी	the goat wore the hat	टोपी न	बकरी पहनी
गाय न	शर्ट पहनी	the cow wore the shirt	शर्ट न	गाय पहनी
गाय न	घास खाड	the cow ate grass	घास न	गाय खाड
गाय न	पतती खाड	the cow ate the leaf	पतती न	गाय खाड
बकरी न	पतती खाड	the goat ate the leaf	पतती न	बकरी खाड
गाय न	साडी पहनी	the cow wore the saree	साडी न	गाय पहनी
लडकी न	साडी पहनी	the girl wore the saree	साडी न	लडकी पहनी
माली न	पंड लगाय	the gardner planted the tree	पंड न	माली लगाया

Table S10 | List of all sentences used in the experiment. (a) English, (b) Taiwanese, and (c) Hindi. The semantically incorrect/odd sentences were formed by swapping the nouns of the correct sentences, without changing the grammatical correctness of the sentence.

Region\nElec	Total	GMLeft	WMLeft	Left	GMRight	WMRight	Right
'Amygdala'	44	22	0	22	22	0	22
'Hippocampus'	65	29	0	29	36	0	36
'Inf-Lat-Vent'	7	3	0	3	4	0	4
'Lateral-Ventricle'	3	2	0	2	1	0	1
'Putamen'	6	3	0	3	3	0	3
'VentralDC'	1	0	0	0	1	0	1
'bankssts'	17	4	0	4	8	5	13
'audalanteriorcingula'	27	8	4	12	7	8	15
'caudalmiddlefrontal'	54	7	23	30	3	21	24
'entorhinal'	14	8	1	9	4	1	5
'fusiform'	44	7	9	16	14	14	28
'inferiorparietal'	57	10	7	17	24	16	40
'inferiortemporal'	75	16	10	26	23	26	49
'insula'	82	14	7	21	29	32	61
'isthmuscingulate'	14	2	3	5	1	8	9
'lateraloccipital'	13	2	0	2	6	5	11
'lateralorbitofrontal'	79	20	21	41	12	26	38
'lingual'	3	0	0	0	3	0	3
'medialorbitofrontal'	57	15	22	37	9	11	20
'middletemporal'	175	54	30	84	61	30	91
'paracentral'	4	0	0	0	1	3	4
'parahippocampal'	9	2	1	3	5	1	6
'parsopercularis'	39	8	7	15	13	11	24
'parsorbitalis'	23	12	4	16	1	6	7
'parstriangularis'	66	21	19	40	8	18	26
'pericalcarine'	4	0	0	0	1	3	4
'postcentral'	24	9	3	12	3	9	12
'posteriorcingulate'	27	4	10	14	2	11	13
'precentral'	59	23	21	44	3	12	15
'precuneus'	19	1	8	9	4	6	10
'stralanteriorcingula'	29	4	16	20	4	5	9
'rostralmiddlefrontal'	87	24	33	57	14	16	30
'superiorfrontal'	74	20	20	40	8	26	34
'superiorparietal'	15	1	1	2	4	9	13
'superiortemporal'	128	43	15	58	37	33	70
'supramarginal'	70	24	9	33	7	30	37
'temporalpole'	38	21	5	26	11	1	12
'transversetemporal'	11	3	5	8	1	2	3
TOTAL	1563	446	314	760	398	405	803

Table S11 | Distribution of electrodes for sentence task over the Desikan-Killiany Atlas
The number of electrodes for different brain regions of the DK atlas (rows) for different

conditions (columns). From the left to right the columns represent the following: (1) Total electrodes, (2) Gray Matter Left, (3) White Matter Left, (4) Total Left, (5) Gray Matter Right, (6) White Matter Right, (7) Total Right.

	Total	Left	Right	Noun	Verb
'caudalmiddlefrontal'	2	2	0	2	0
'fusiform'	2	0	2	1	1
'inferiorparietal'	1	1	0	1	0
'inferiortemporal'	2	2	0	2	0
'insula'	2	1	1	1	1
'middletemporal'	4	1	3	4	0
'parahippocampal'	1	0	1	1	0
'parsopercularis'	3	2	1	1	2
'parsorbitalis'	1	1	0	1	0
'parstriangularis'	6	4	2	5	1
'postcentral'	1	1	0	1	0
'precentral'	7	7	0	1	6
'rostralmiddlefrontal'	2	1	1	1	1
'superiorfrontal'	1	1	0	0	1
'superiortemporal'	3	2	1	2	1
'supramarginal'	1	1	0	0	1
'Hippocampus'	2	0	2	2	0
TOTAL	41	27	14	26	15

Table S12 | Electrode locations of all the electrodes on the Desikan-Kiliany Atlas, that had a significant contribution of the Nouns versus Verbs predictor in the GLM. From the left to right the columns represent the following: (1) Total electrodes, (2) left or, (3) right hemisphere, (4) noun- or, (5) verb-preferring. Significant regions showing lateralization shown in bold. ($p < 10^{-5}$, permutation test, $n = 10^6$ iterations, regions with less than 4 electrodes were excluded).