Supplementary Information

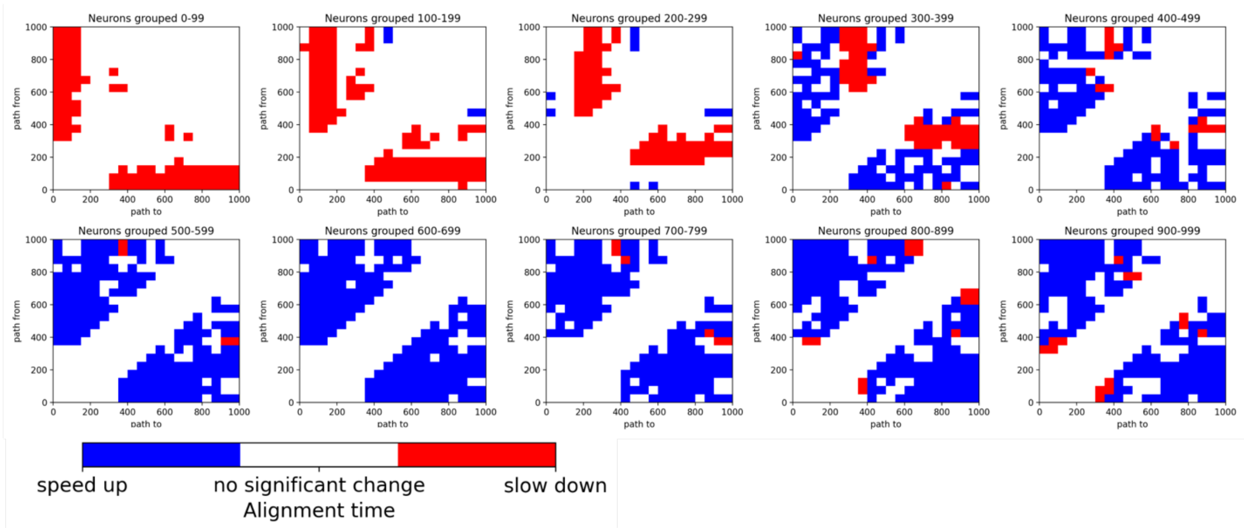

Figure S 1 Alignment time change in an EDR based connectome due to long-range pathway insertion Systematic exploration of the effect of bidirectional pathway insertion at a distance of 300 neurons from the main diagonal of the connectome matrix. The effect of either significant speed up (blue) or slowdown (red) is shown for all 10 groups of neurons of the reservoir. While input receiving neurons (0-299) are mainly slowed down and neurons in the 2nd half of the reservoir (500-999) are mainly sped up, the neurons close to the input region (300-500) can show both effects due to pathway insertion.

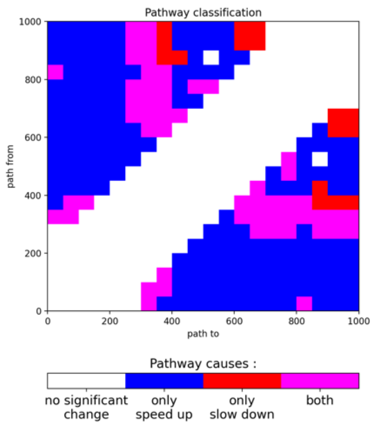

Figure S 2 Classification of inserted pathways in the EDR reservoir, whether they strictly produce a speed up, a slow down, both or no significant change across all the neurons which do not directly receive an input (i.e. neurons with ID > 299).

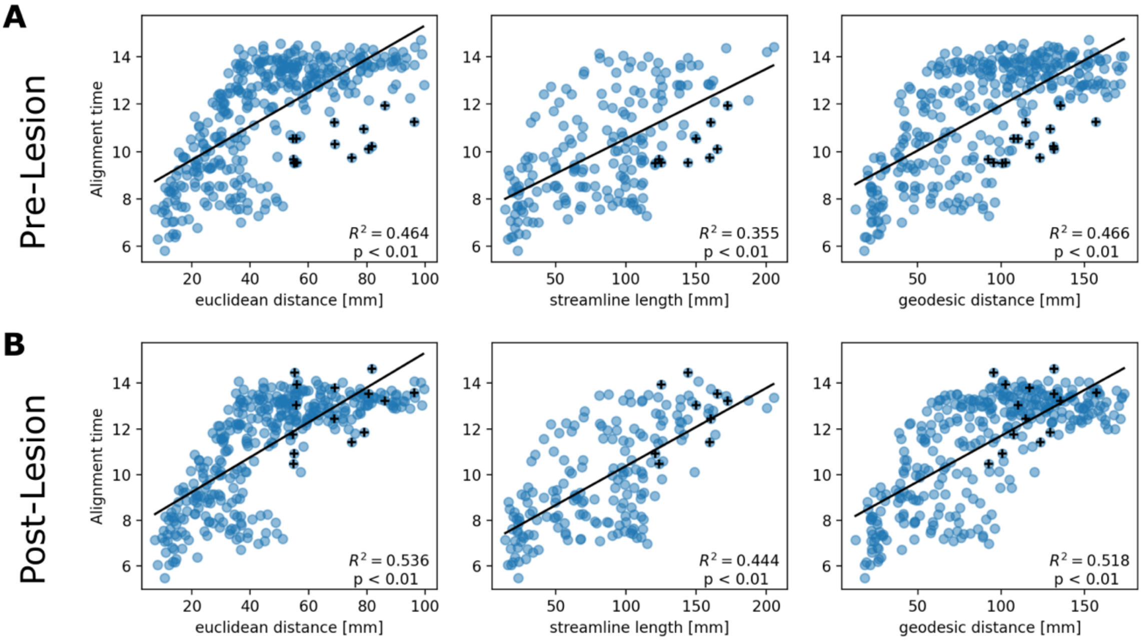

Figure S 3 Alignment times (from Error! Reference source not found.**) as a function of three distance metrics**. **(A)** Alignment times of brain regions as a function of 3 different distance measures, from the brain region to the input visual network. The black line indicates a linear model fit. Observations marked with a black "+" are indicating the regions of the OFC and PFC (from **Error! Reference source not found.** A). **(B)** Same as panel (A) but after removal of the IFO bundle.

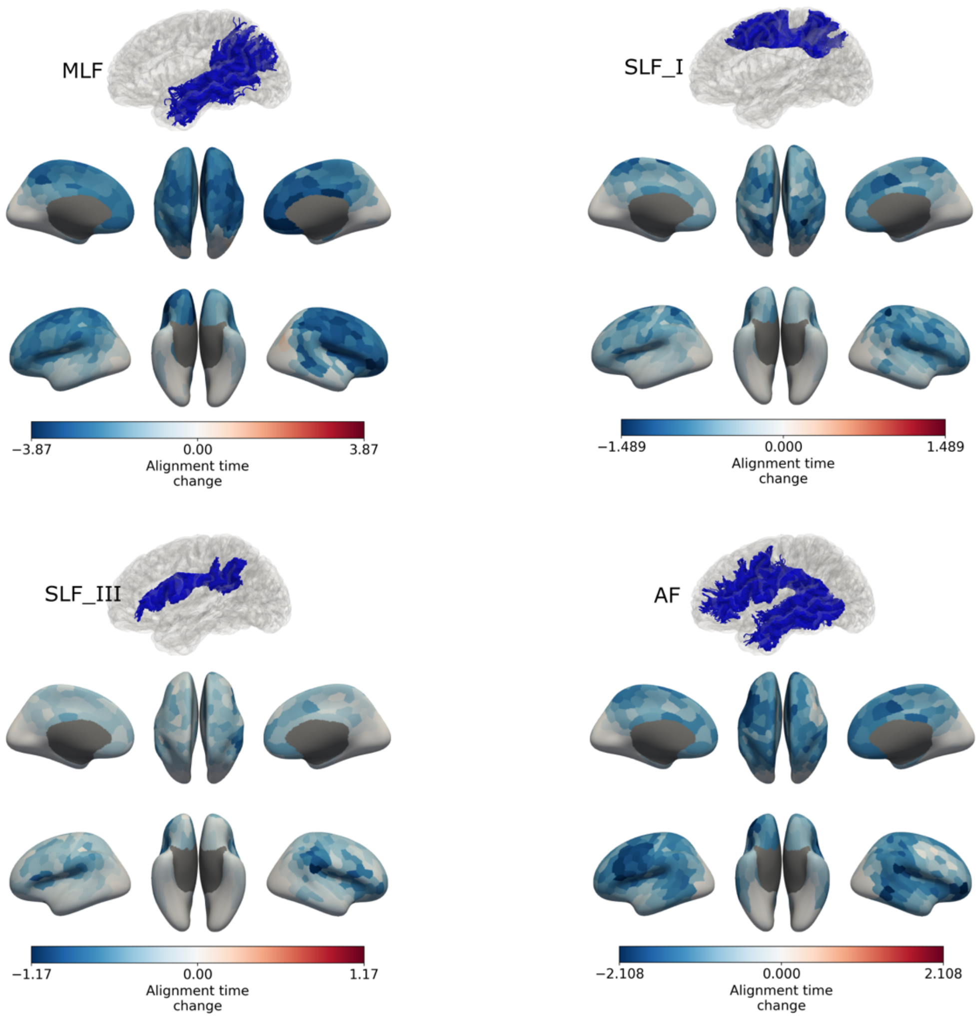

Figure S 4 Alignment time change in a full brain connectome due to specific fibre bundle removal. Top and bottom row show the effect of a bilateral lesion of a specific fibre bundle on the alignment times when the input is projected onto the visual network. The bundles, MLF SLF_I/III and MLF, show widespread or localized increases of processing times, they are rather associative pathways.

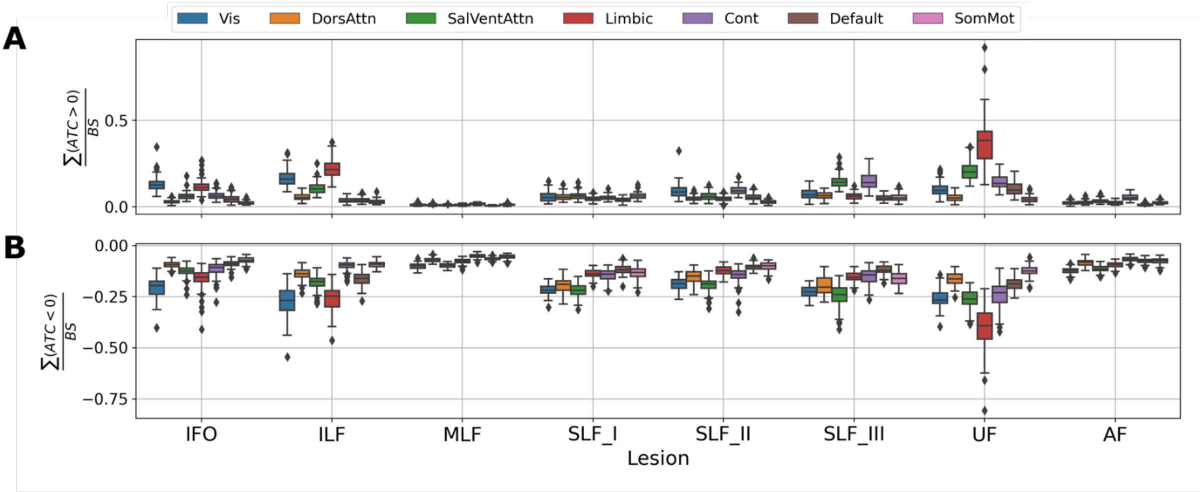

Figure S 5 Global effect of fibre bundle removal for each of the 7 input networks weighted by bundle size. (A) Each box indicates the distribution of positive alignment time change (ATC) summed across all brain regions for all subjects, as an overall measure of the effect of a specific fibre bundle removal. Each sample is divided by the bundle size (BS), i.e. the number of brain regions the bundle connects. The network, to which the intact/scrambled narrative was projected to, is indicated by the color of the box. **(B)** Same as (A) but for negative ATCs.

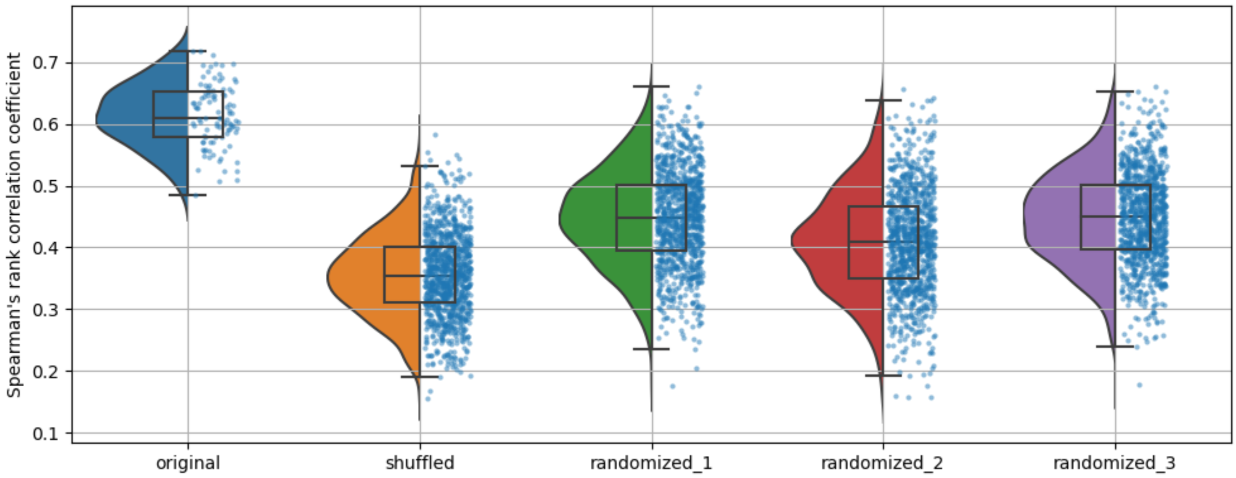

Figure S 6 Correlations between predicted and empirical alignment times across original connectome and null-model connectomes. "original" refers to the subject-wise connectome as estimated from diffusion imaging data. "shuffled" refers to unconstrained randomization of the links of the original connectome. "randomized_1" used the function **null_model_und_sing** of the brain connectivity toolbox, which randomizes links of the original connectome, while preserving degree and strength distributions. "randomized_2" used the function **randmio_und** of the brain connectivity toolbox, which randomizes links of the original connectome, while preserving degree but not strength distributions. "randomized_3" used the function **latmio_und** of the brain connectivity toolbox, which latticizes the connectome, by swapping links of the connectome placing them between neighbours in close spatial proximity. Each randomization was done 10 times per connectome. Pairwise onesided Mann-Whitney U test between the results of the original and any of the null-model connectome resulted in a statistically significant difference with at least $p<10^{-52}$.

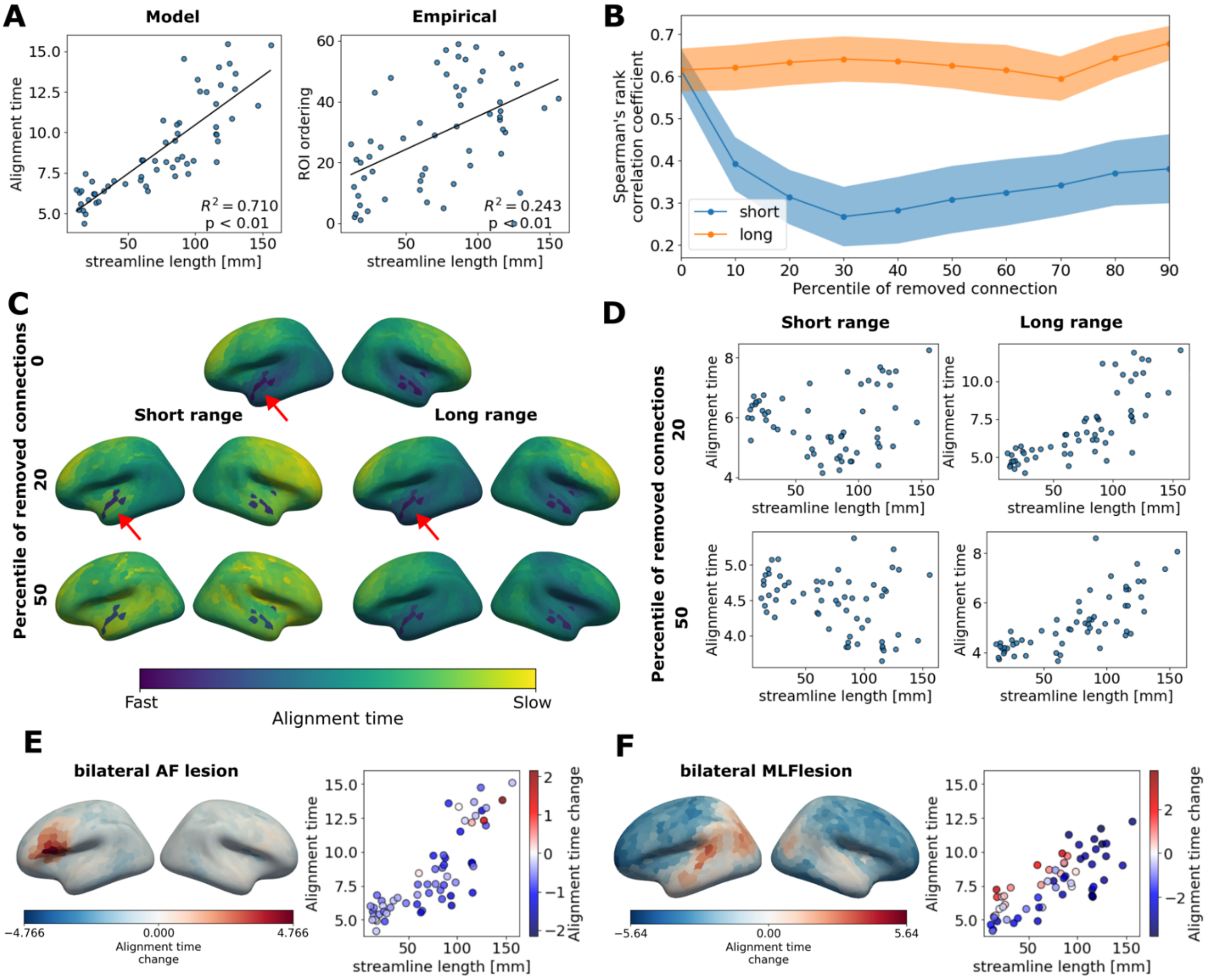

Figure S 7 Impact of removing shortest/longest connections by percentile on simulated alignment times when projecting the intact/scrambled narrative to the 5 fastest regions (of Chien and Honey, 2020) in the temporal lobe of the full brain connectome. (A) Alignment times from the model (i.e. **Error! Reference source not found.** A) and ROI orderings according to empirically measured alignment times as a function of the shortest streamline length from the input areas. For both, model and empirical measurement, a clear increase in alignment times with increasing distance can be observed. The scatter plots only show the regions for which an empirical measurement was give. **(B)** The correlation between simulated and empirically measured alignment times as a function of the percentile of removed connections. Removal either starts with the longest (orange) or with the shortest (blue) connections. The solid line (shaded area) indicates the mean (standard deviation) across 100 subjects. Removing longest connections keeps the model intact to produce similar ordering of alignment times, while removing only 30% of shortest connections cuts the correlation between model and empirical measurement approximately into half. **(C)** Examples of alignment time distributions on the inflated surface for the intact connectome (i.e. 0^{th} percentile) or after removal of shortest or longest connections (i.e. 20^{th} and 50^{th} percentiles). The red arrow indicates the region in the temporal lobe close to the areas receiving the narrative input. In the intact connectome the simulated alignment time for regions in this area is fast. They are connected via short range connections to the input receiving areas. Removing all shortest connections below the 20^{th} percentile severely impacts the alignment time of regions in that area, while this does not happen for the removal of longest connections. **(D)** Scatter plots of alignment times as a function of the shortest streamline length from the input areas for the surface plots in panel (C). The clear relationship of increasing alignment times with increasing distance is broken apart for the removal of shortest connections, while it is still intact for the removal of longest connections. **(E)** Example of long-range fibre bundles acting as a short cut to speed up alignment times of distant regions. The left side shows the change in simulated alignment times after a bilateral removal of the AF bundle. The right side shows a scatter plot of simulated alignment times after AF removal for regions for which a empirical measurement was available. The color indicates the change in simulated alignment times compared to the intact connectome. A few scatter points at long distances are colored in red, indicating a slow down effect due to AF bundle removal. **(F)** Same as (E) but for the removal of the MLF bundle.

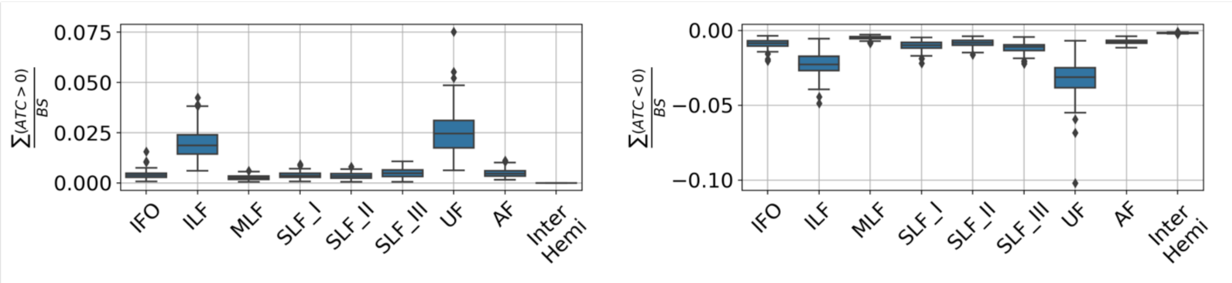

Figure S 8 Impact of bilateral lesions on alignment times within the language network when the input timeseries in projected onto the auditory regions from (Error! Reference source not found. **A).** Left (right) boxplot panel shows positive (negative) alignment time change (ATC) summed across all brain regions for all subjects, as an overall measure of the effect of a specific fibre bundle removal. Each sample is divided by the bundle size (BS), i.e. the number of brain regions the bundle connects.

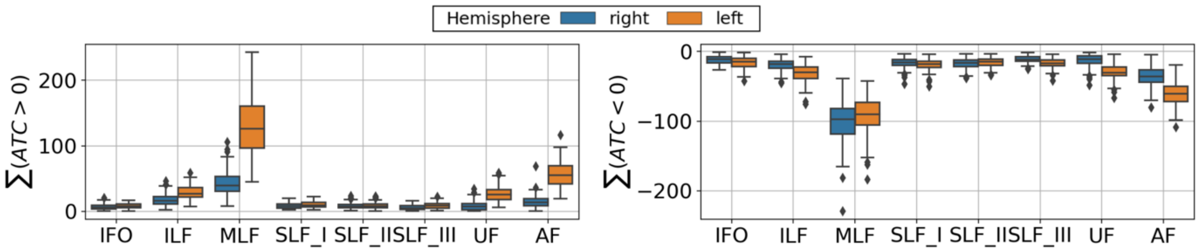

Figure S 9 Impact of unilateral lesions, removing either the left or right hemispheric fibre bundle, on alignment times within the language network when the input timeseries in projected onto the auditory regions from (Error! Reference source not found. **A).** Left (right) boxplot panel shows positive (negative) alignment time change (ATC) summed across all brain regions within the language network for all subjects, as an overall measure of the effect of a specific fibre bundle removal. The color of the box indicates from which hemisphere the fibre bundle was removed.