Figure 1. Schematic and Simulations

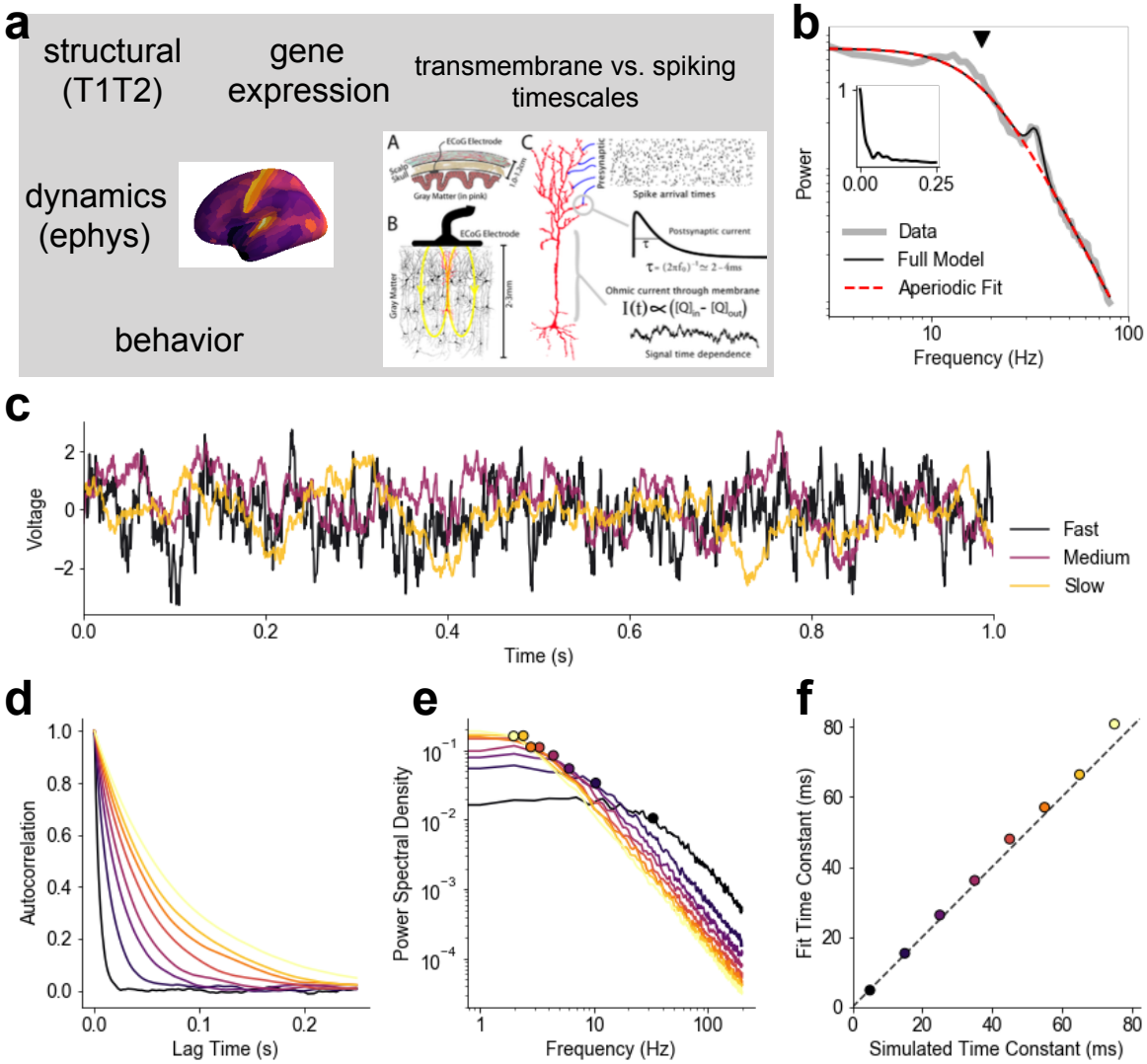

Figure 1| Schematic of study, method, & simulation. a, we estimate cortical synaptic and transmembrane timescales from surface ECoG recordings, and compare with spiking population timescales, anatomical hierarchy, and gene expression gradients, as well as investigate their dynamic modulation during behavior. b, characteristic timescale (decay time constant) of a system can be estimated from its power spectral density as the frequency of power drop-off (black triangle) via eq. 2. An example ECoG PSD is shown, with the corresponding model fit; inset: autocorrelation function. c-f, simulated time series (c) with increasing (longer) autocorrelation decay time constants (d), which can be accurately estimated from the PSD (e), retrieving the ground truth parameter values (f).

Figure 2. Monkey ECoG vs. SU

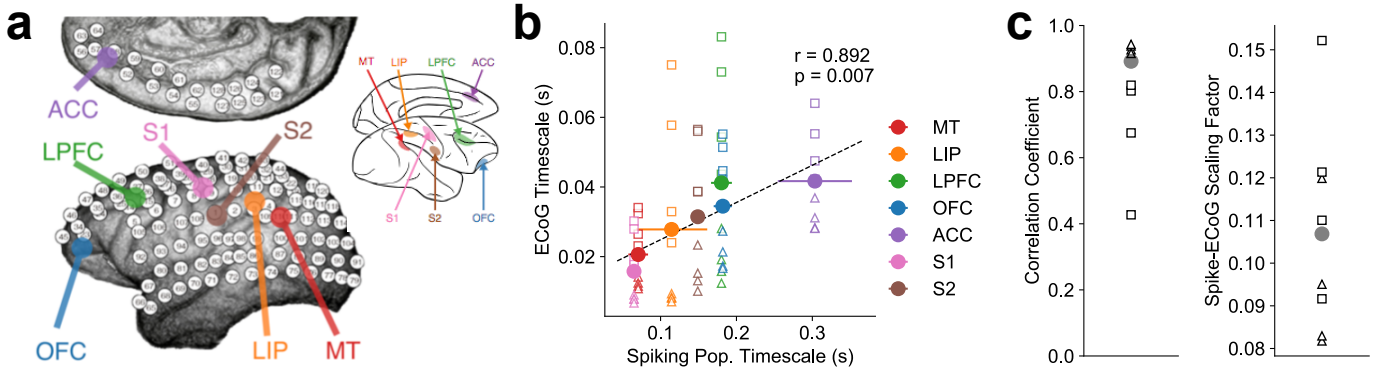

Figure 2| Local transmembrane timescale scales with population spiking timescale across macaque cortex, following functional hierarchy. a, whole-cortex ECoG grid is shown, highlighting corresponding regions with published single-unit data taken from [ref] (inset). b, Transmembrane (ECoG) timescale increases along cortical hierarchy, and is tightly correlated with spiking timescale estimated from multiple single-unit population spiking autocorrelation in [ref]. Hollow markers denote individual session estimates, shapes denote different animals. Solid circles denote grand average over all sessions and animals. c, linear regression fit to individual sessions show robust correlation between timescale estimates, while transmembrane timescales are consistently an order of magnitude faster than spiking population timescales.

Figure 3. Human ECoG & Gene Expression

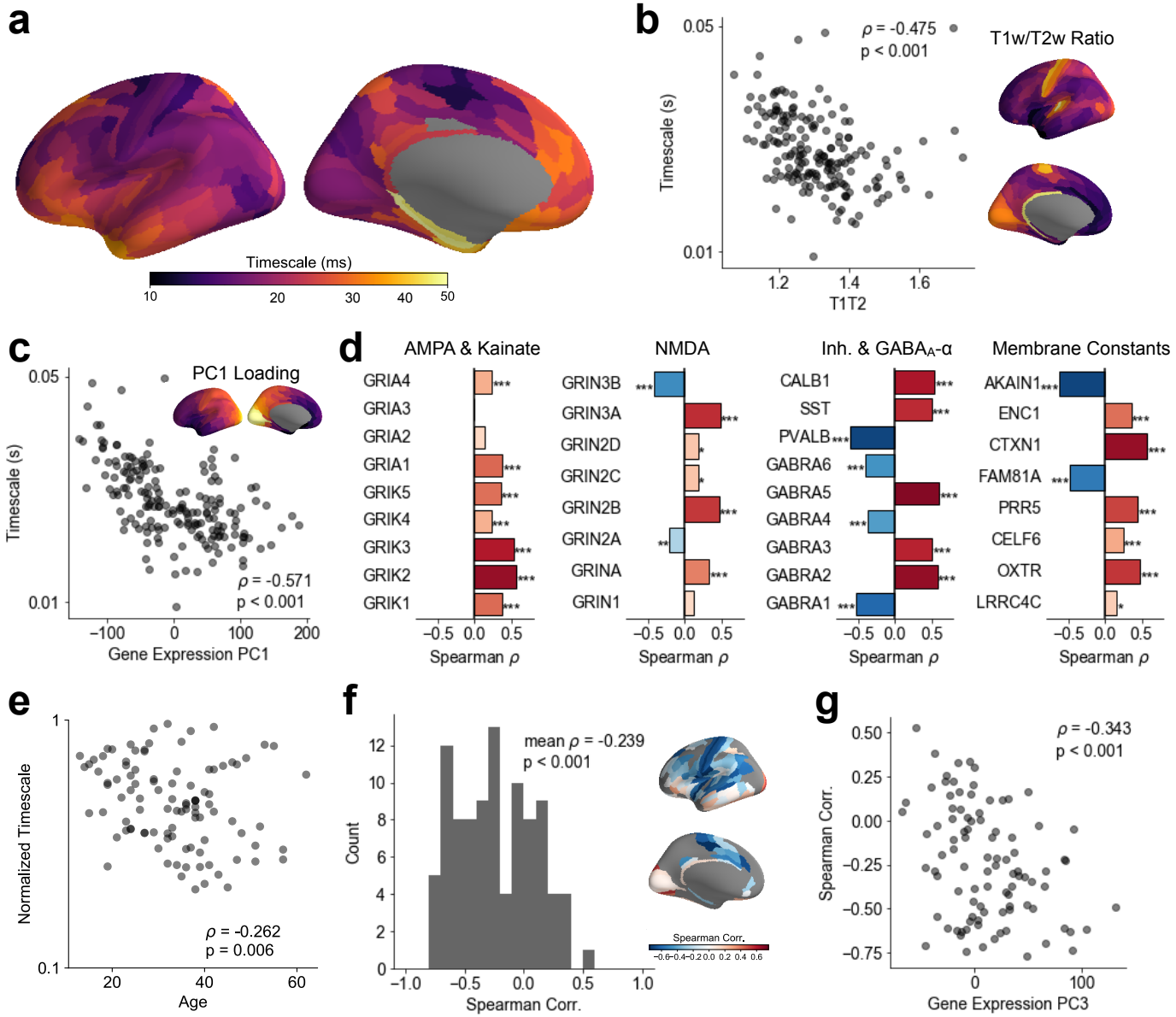

Figure 3|

Figure 4. Human ECoG & Working Memory

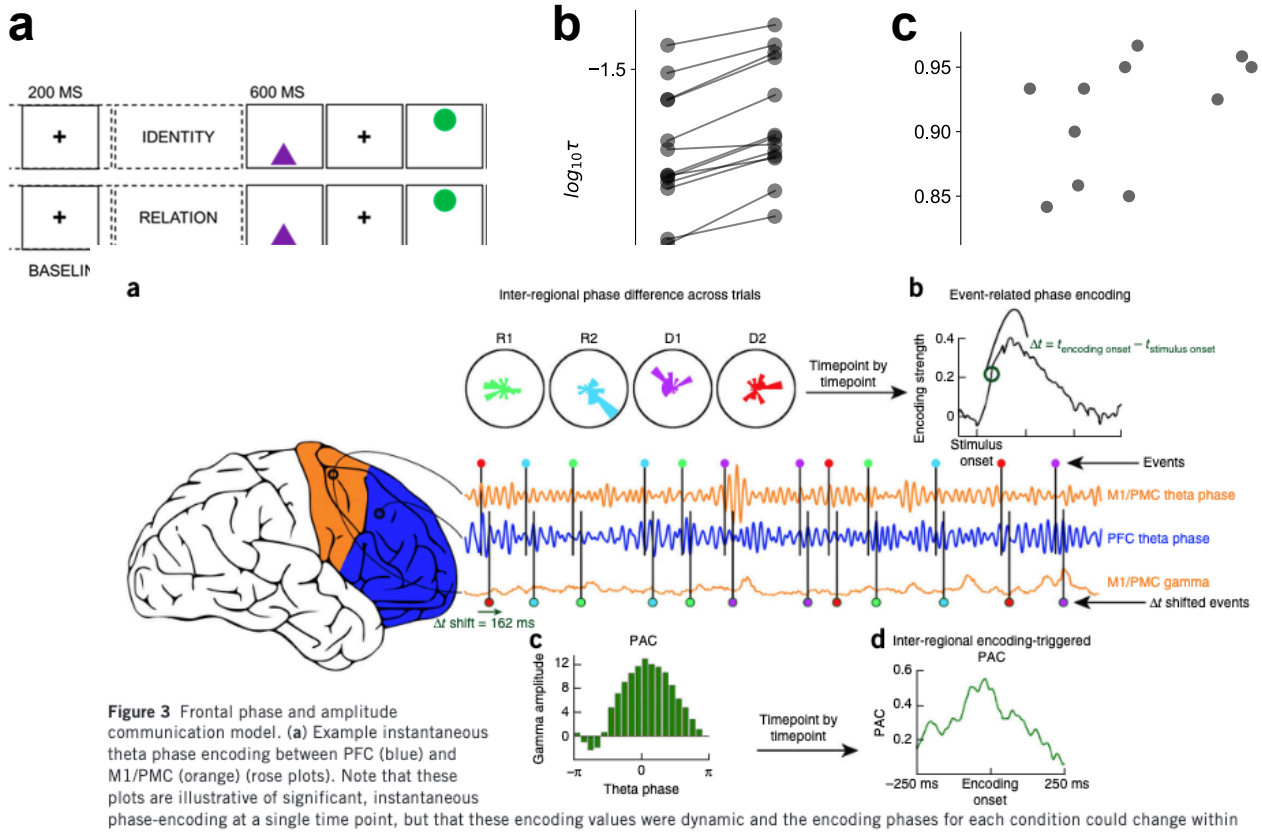

Figure 3 Frontal phase and amplitude communication model. (**a**) Example instantaneous theta phase encoding between PFC (blue) and M1/PMC (orange) (rose plots). Note that these plots are illustrative of significant, instantaneous phase-encoding at a single time point, but that these encoding values were dynamic and the encoding phases for each condition could change within a trial, across trials and across channel pairs. (**b**) The onset of significant phase encoding relative to the stimulus onset (Δt) differs for each encoding electrode pair (Online Methods). This relationship is shown for an example pair of M1/PMC and PFC electrodes, along with the corresponding gamma amplitudes in M1/PMC, across multiple trial events. (**c**,**d**) Following the onset of significant phase encoding, event-related theta phase/high gamma amplitude PAC could be evaluated (**c**). As seen in this example, PAC was statistically assessed as a non-uniformity in the distribution of high gamma amplitude relative to the theta phase difference between PFC and M1/PMC sites such that, for an illustrative case (**d**), inter-regional encoding-triggered PAC provided an index of frontal communication via temporally specific high gamma increases during inter-regional theta phase encoding.

task schematic