Supplementary Data

Selection of the Range of Sliding Window Length

In this work, we used sliding windows to calculate dynamic functional connectivity (FC) at each time instant. The window length was determined by Dickey-Fuller (DF) test (Said and Dickey, 1984). However, this hypothesis test was just for testing stationarity for a given time series, that is, to test the existence of unit root. It did not provide the window length that is most appropriate for correlation calculation. Consequently, there remained two issues to solve. First, at a given time point, for all window lengths that can successfully reject the null hypothesis (i.e., those window lengths within which the time series were stationary), which one should be chosen for appropriate calculation of dynamic FC? Second, within what range of window lengths should the DF test be conducted?

We adopted the following strategy in order to answer the first question. At a given time point, we started performing the DF test from the specified minimum window length and increased the window length by one time point (or one repetition time [TR]) if it could not reject the null hypothesis. Once stationarity was established at some window length for all 190 regions, we stopped performing the test and used these windowed time series to calculate FC. In other words, the minimum length of the window that was stationary for all 190 regions was used. This strategy ensured that maximum available dynamics in FC were captured.

The second question pertains to the specification of the range of window length $[m_-, m_+]$ within which the DF test should be conducted. The factors guiding the choice of the window length are elaborated below. Time series $y(t)$ can be modeled as an AR(1) process shown by the following equation.

$$y(t) = \alpha y(t-1) + \varepsilon(t) \tag{S1}$$

Where t is the time index, α is a coefficient, and $\varepsilon(t)$ is the error term. A unit root is present when $\alpha = 1$, in which case, the mean and variance of $y(t)$ are a function of time (t). This implies that $y(t)$ is nonstationary. Given that our time series are restricted to the frequency band [0.01 Hz, 0.1 Hz], we provide a frequency domain explanation for the choice of minimum and maximum window lengths considered in this work. For a signal with highest and lowest frequencies of 0.1 and 0.01 Hz, period T ranges from 10 to 100 sec. If we chose the maximum window length to be 100 sec, then we can make sure that the window covers at least one period of the slowest-varying signal component. Similarly, if we chose a minimum window length of 10 sec, then we can guarantee that the window covers at least one period of the fastest-varying signal component. It is imperative that the window encompasses at least one period of signal variation to capture its dynamics. The aforementioned strategy ensures that the minimum window length can capture maximum-available dynamics. Since functional magnetic resonance imaging data used in this work had a TR = 0.72 sec, the minimum window length should be at least 10/0.72 = 14 (TRs), and maximum length should be 100/0.72 = 140 (TRs). This range was employed in this work.

As for simulations, we assumed that the sampling rate was 1 sample/sec (TR = 1 sec), so to be consistent, the minimum window length should be 10/1 = 10 (TRs), and maximum length should be 100/1 = 100 (TRs).

Supplementary Reference

Said SE, Dickey DA. 1984. Testing for unit roots in autoregressive moving average models of unknown order. Biometrika 71:599–607.