Supplementary Notes 1

Calculation of the expected mean age of new spines that were seen only once

Consider new spines that are born at time $t$ in the interval $0 - T$, where $T = 4$ days is the imaging interval. The probability for a spine born at time $t$ to survive to $T$ is

$$P(t) = \exp\left(-\frac{(T-t)}{\tau}\right),$$

where $\tau$ is the mean age of a new spine before retraction. Since the rate of generating new spines is constant per unit time, the rate of generating new spines that survive until $T$ is given by

$$\rho(t) = A \exp\left(-\frac{(T-t)}{\tau}\right),$$

where $A$ is a normalization constant. Since $\int \rho(t) dt = 1$, $A = \left[\tau(1-\exp(-T/\tau))\right]^{-1}$ and

$$\rho(t) = \frac{\exp\left(-\frac{(T-t)}{\tau}\right)}{\tau(1-\exp(-T/\tau))}.$$

The expected mean age of the new spines can then be calculated as:

$$\langle t_\tau \rangle = \int_0^T (T-t) \rho(t) dt.$$

$$\langle t_\tau \rangle = \tau \frac{\left(1-\exp(-T/\tau)(1+T/\tau)\right)}{\left(1-\exp(-T/\tau)\right)}.$$

Using the values $T = 4$ days, $\tau = 2.4$ days (calculated from data used in Holtmaat et al. (2006) Nature 441, 979-83), the expected mean age of the new spines is about 1.5 days.