Hierarchical dynamics of informational patterns and decision making

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Supplementary Material:

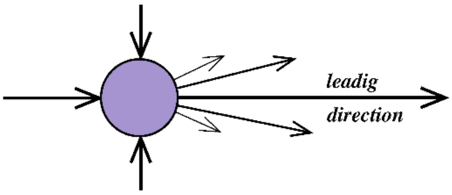

Figure S1. Illustration of a metastable state with several unstable separatrices: the system is moving with highest probability along the leading direction that corresponds to the largest positive eigenvalue λ_j.

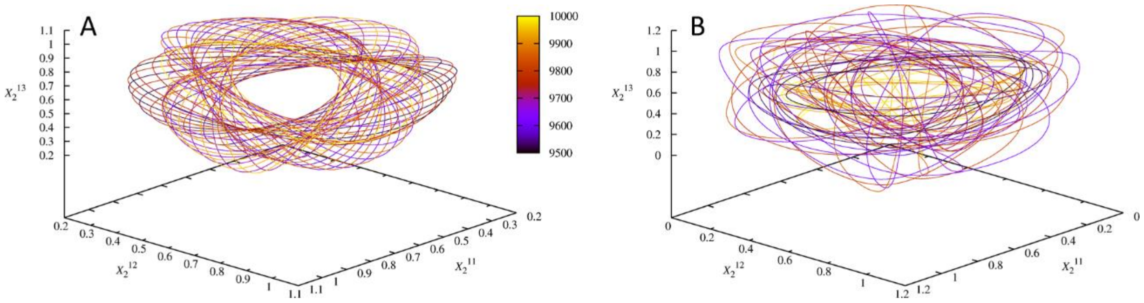

Figure S2: Projection of events X_2^{1m} in three different modalities m=1,2,3 as described by equation (3.1). All parameters are specified below. Time is encoded in the color bar. Panel A: One can see the forbidden region in the center of the figure which is related to the strong (ξ=0.8) competition between different modalities. Panel B: For weaker modality coupling values (e.g. ξ=0.5), this forbidden region disappears.

Model parameters

Model parameters for equations (2.3)−(2.6), Figs. 2 and 3:

$N^k_{events} = 3;\ k = 1,2,3$

$\sigma_1^0 = 7.24,\ \sigma_2^0 = 5.85,\ \sigma_3^0 = 8.30;$

$\sigma_1^1 = 9.93,\ \sigma_2^1 = 6.0,\ \sigma_3^1 = 5.18;\ \sigma_1^2 = 7.21,\ \sigma_2^2 = 5.79,\ \sigma_3^2 = 8.41,;\ \sigma_1^3 = 8.29,\ \sigma_2^3 = 7.86,\ \sigma_3^3 = 9.16$

$\rho_{ii}^k = 1;\ k = 0,1,2,3;\ i = 1,2,3$

$\rho_{12}^0 = \sigma_1^0 / \sigma_2^0 + 0.51;\ \rho_{21}^0 = \sigma_2^0 / \sigma_1^0 - 0.5;\ \rho_{23}^0 = \sigma_2^0 / \sigma_3^0 + 0.51;$

$\rho_{32}^0 = \sigma_3^0 / \sigma_2^0 - 0.5;\ \rho_{31}^0 = \sigma_3^0 / \sigma_1^0 + 0.51;\ \rho_{13}^0 = \sigma_1^0 / \sigma_3^0 - 0.5;$

$\rho_{12}^1 = \sigma_1^0 / \sigma_2^0 + 0.51;\ \rho_{21}^1 = \sigma_2^0 / \sigma_1^0 - 0.5;\ \rho_{23}^1 = \sigma_2^0 / \sigma_3^0 + 0.51;$

$\rho_{32}^1 = \sigma_3^0 / \sigma_2^0 - 0.5;\ \rho_{31}^1 = \sigma_3^0 / \sigma_1^0 + 0.51;\ \rho_{13}^1 = \sigma_1^0 / \sigma_3^0 - 0.5;$

$\rho_{12}^2 = \sigma_1^0 / \sigma_2^0 + 0.51;\ \rho_{21}^2 = \sigma_2^0 / \sigma_1^0 - 0.5;\ \rho_{23}^2 = \sigma_2^0 / \sigma_3^0 + 0.51;$

$\rho^2_{32} = \sigma^0_3 / \sigma^0_2 - 0.5;\ \rho^2_{31} = \sigma^0_3 / \sigma^0_1 + 0.51;\ \rho^2_{13} = \sigma^0_1 / \sigma^0_3 - 0.5;$
$\rho^3_{12} = \sigma^0_1 / \sigma^0_2 + 0.51;\ \rho^3_{21} = \sigma^0_2 / \sigma^0_1 - 0.5;\ \rho^3_{23} = \sigma^0_2 / \sigma^0_3 + 0.51;$
$\rho^3_{32} = \sigma^0_3 / \sigma^0_2 - 0.5;\ \rho^3_{31} = \sigma^0_3 / \sigma^0_1 + 0.51;\ \rho^3_{13} = \sigma^0_1 / \sigma^0_3 - 0.5;$
τ_e=0.899, b=0.01, τ_E=0.7, θ=1.1, β^I=1
$\xi^{11} = 1,\ \xi^{12} = 1.4,\ \xi^{13} = 0.5; \xi^{21} = 0.5,\ \xi^{22} = 1,\ \xi^{23} = 1.4; \xi^{31} = 1.4,\ \xi^{32} = 0.5,\ \xi^{33} = 1$

Model parameters for equations (3.1)−(3.5):
$N_{events} = 6;\ k = 1,2,3;\ M = 3$
$\sigma^m_1 = 1.73,\ \sigma^m_2 = 1.123,\ \sigma^m_3 = 1.301,\ \sigma^m_4 = 1.203,\ \sigma^m_5 = 1.458,\ \sigma^m_6 = 1.903;\ m = 1,\ldots,M$
$\rho^{km}_{ii} = 1;\ \forall k, m$
$\rho^{km}_{13} = \rho^{km}_{35} = \rho^{km}_{51} = 5.0;\ \rho^{km}_{46} = \rho^{km}_{24} = \rho^{km}_{62} = 2.0;\ \rho^{km}_{16} = \rho^{km}_{21} = \rho^{km}_{32} = \rho^{km}_{43} = \rho^{km}_{54} = \rho^{km}_{65} = 1.5; \forall k, m$
Only $\rho^{km}_{ji} \neq 0$ are indicated above.
$\tau_{X_i} = 1;\ \tau_Y = 0.1;\ b' = 0.1; \theta = 0.05; \zeta_k = 0.2$

Fig. S2A and Fig. 4b:
$\xi^{k11}_{11} = \xi^{k12}_{11} = \xi^{k23}_{11} = \xi^{k31}_{11} = \xi^{k11}_{33} = \xi^{k12}_{33} = \xi^{k23}_{33} = \xi^{k31}_{33} = \xi^{k11}_{55} = \xi^{k12}_{55} = \xi^{k23}_{55} = \xi^{k31}_{55} = 0.8;\ \forall k$
Only $\xi^{kml}_{ij} \neq 0$ are indicated above.
Fig. S2B:
$\xi^{k11}_{11} = \xi^{k12}_{11} = \xi^{k23}_{11} = \xi^{k31}_{11} = \xi^{k11}_{33} = \xi^{k12}_{33} = \xi^{k23}_{33} = \xi^{k31}_{33} = \xi^{k11}_{55} = \xi^{k12}_{55} = \xi^{k23}_{55} = \xi^{k31}_{55} = 0.5;\ \forall k$
Only $\xi^{kml}_{ij} \neq 0$ are indicated above.