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Interareal coupling reduces encoding variability in multi-area models of spatial working memory

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$j = 1, 2$ … $j \neq k$. F… $C_j(x) = c_j$ … (x). … $C_c(x) = c_c$ … (x). … $c_c \to 0$, … $c_c \to$ … (c_1, c_2), … F… $c_1 = c_2 = c_c = 1$, …

MULTIPLE-AREA MODEL OF SPATIAL WORKING MEMORY

… N …

$$\tau\, d u_j(x,t) = \left[-u_j + \varepsilon^{1/2} \sum_{k=1}^{N} w_{jk} * f(u_k) \right] dt + \varepsilon^{1/2}\, dW_j(x,t) \tag{6}$$

… u_j … j … $j = 1, \ldots, N$. A… $\tau = 1$, … 10 … $w_{jk}(x-y)$ … k … y … j … x … (E… 2). F… (E… 3) … (E… 4) … H… (E… 5). A… $W_j(x,t)$ … $\langle dW_j(x,t) \rangle = 0$ …

$$\langle dW_j(x,t)\, dW_k(y,s) \rangle = C_{jk}(x-y)\delta(t-s)\, dt\, ds,$$

… $j, k = 1, \ldots, N$, … $j = k$ … $j \neq k$. F… $C_{jj}(x) =$ … (x) … $C_{jk}(x) = c_c$ … (x) … $j \neq k$.

NUMERICAL SIMULATION OF STOCHASTIC DIFFERENTIAL EQUATIONS

… (E… 1) … E… M… 10^{-4}, … R… 2000 … $\langle \Delta_1(t)^2 \rangle$ … 5000 … Δ_j … x … j … $u_j(x,t)$ …

RESULTS

… (A…, 1977; C… 1998; E…, 1998). I… P… I… O… O…

BUMPS IN THE NOISE-FREE SYSTEM

… E… (1) … $(\varepsilon \to 0)$. … (E…, 1998; H…, 1998

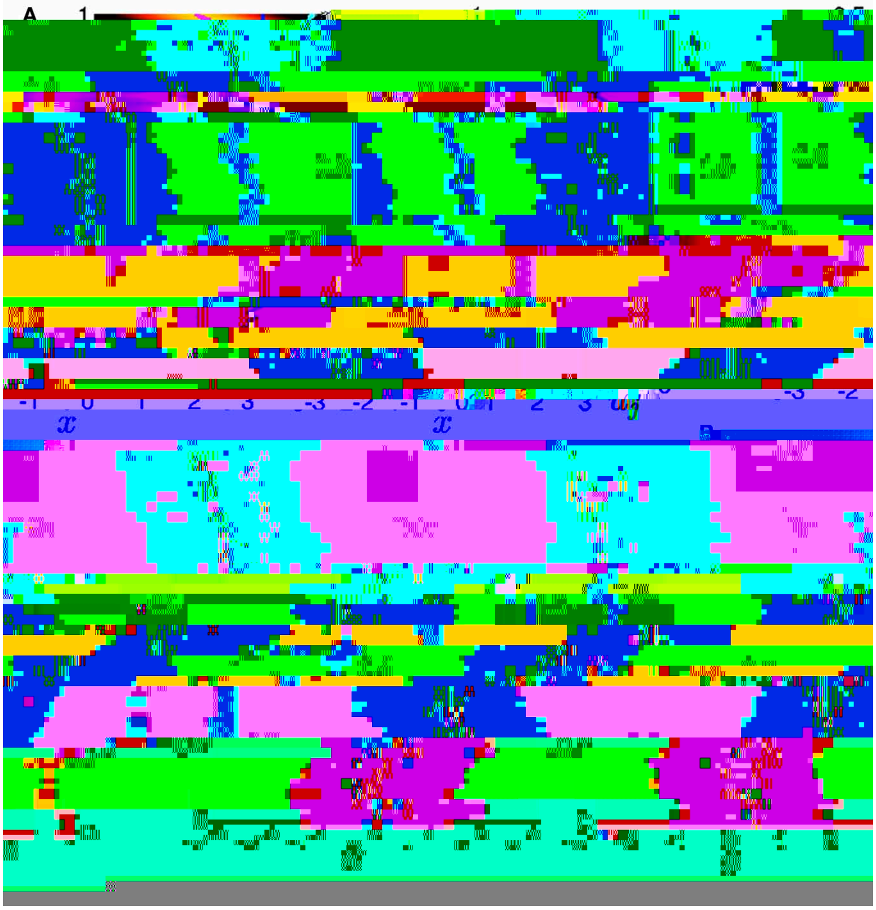

FIGURE 2 | Diffusion of bumps in the dual area stochastic neural field (Equation 1). (A) W e a ea c ec ($w_{12} = w_{21} \equiv 0$), eac b e ec e B a ab e d a , d e c a c ce . **(B)** I e e e ce e a ea c ec $\sqrt{\varepsilon}w_{12}(x) = \sqrt{\varepsilon}w_{21}(x) = 0.01(\cos(x) + 1)$, e b 1 (a e a) a ac ed e b 2 (c a) a d ce e a. D e e e e eac b e e , b b e ec e a de e d a e . L ca c ec de c bed b e c e (E a 3); e a e c E a (5). O e a a e e a e e d $\theta = 0.5$ a d e a de $\varepsilon = 0.025$.

$\Phi = (\Phi_1(x,t), \Phi_2(x,t))^T$; … $\mathcal{L}$ …

$$\mathcal{L} = \begin{pmatrix} -u(x) + w(x) * [f'(U_1(x))u(x)] \\ -v(x) + w(x) * [f'(U_2(x))v(x)] \end{pmatrix}$$

… $= (u(x)\ v(x))^T$ … $(U_1', 0)^T$ … N … $(0, U_2')^T$, … $\mathcal{L}$ … E (10). … E (12) … $|\Delta_1 - \Delta_2|$ …

$$f(U_j(x + \Delta_k - \Delta_j)) \approx f(U_j(x)) + f'(U_j(x))U_j'(x) \cdot (\Delta_k - \Delta_j),$$

… $j = 1, 2$ … $k \neq j$. … E (12) …

… $\mathcal{L}^*$, …

$$\int_{-\pi}^{\pi} {}^T\mathcal{L}\, x = \int_{-\pi}^{\pi} {}^T\mathcal{L}^*\, x,$$

… $= \begin{bmatrix} p(x)\ q(x) \end{bmatrix}^T$. I …

$$\mathcal{L}^* = \begin{pmatrix} -p(x) + f'(U_1(x))[w(x) * p(x)] \\ -q(x) + f'(U_2(x))[w(x) * q(x)] \end{pmatrix}. \qquad (13)$$

… $_1 = (f'(U_1)U_1', 0)^T$ … $\mathcal{L}^*$ … E (13) …

$$\mathcal{L}^*\ _1 = \begin{pmatrix} -f'(U_1)U_1' + f'(U_1)[w * [f'(U_1)U_1'] \\ 0 \end{pmatrix} = \mathbf{0}$$

(t) E (17). E (19), $^T = (\ ^{-1})^T \Lambda\ ^T$, $_t = (\ ^{-1}$

Φ_j.

Δ_j.

$$u_j = U_j(x - \Delta$$

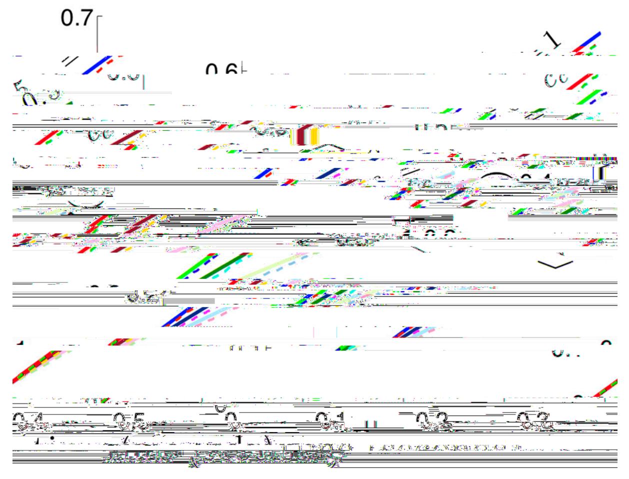

FIGURE 6 | Variance in the position of bumps as noise correlation between areas is increased. ... (29) ... ($c_c = 0$) ... ($c_c = 0.5, 1$), ... $c_c = 1$ ... $\langle \Delta(t)^2 \rangle$ ... (29) ... $c_c \to 1$). ... **Figure 2**.

(E 30). E (31) $|\Delta_k - \Delta_j|$ j, k. E (31), $\mathcal{L}^*$.

$$\int_{-\pi}^{\pi} \mathbf{\Upsilon}^T \mathcal{L} \mathbf{\Psi} \, x = \int_{-\pi}^{\pi} \mathbf{\Psi}^T \mathcal{L}^* \mathbf{\Upsilon} \, x$$

$\mathbf{\Upsilon} = (\Upsilon_1(x), \ldots, \Upsilon_N(x))^T$

$$\mathcal{L}^* \mathbf{\Upsilon} = \begin{pmatrix} -\Upsilon_1(x) + f'(U_1(x))[w * \Upsilon_1] \\ \vdots \end{pmatrix}$$

$$= \kappa J_N - N\kappa I$$

J_N $N \times N$ I J_N $N,$ $N - 1.$ $= \kappa J_N - N\kappa I$ $\lambda_1 = 0$ $_1 = (1, \ldots, 1)^T$. A $\lambda_j = -N\kappa$ $j \geq 2,$ $_j = \; _1 - \; _j,$ j

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