

Table 3. Connections between neural areas in Darwin XI’s simulated nervous system. A presynaptic neuronal unit connects to a postsynaptic neuronal unit with with a given probability (P) and a given projection topology (Arbor). This arborization shape can be rectangular with a particular height and width “ \square h x w”, doughnut-shaped with an inner and outer radius “ Θ r1 x r2”, nontopological ”nontopo” in which any pair of presynaptic and postsynaptic neurons have an equal probability of being connected, or “S2Special” indicating that the post-synaptic neuronal unit took input from 3 neuronal units, each of which was in a different subarea of S1. The initial connection strengths $c_{ij}(0)$ are set with uniform random probability within the range given by (minimum, maximum) in that column. A negative value of $c_{ij}(0)$ denotes inhibitory connections. Connections can be either voltage-independent (VI) or voltage-dependent (VD). ϕ denotes the persistence of the synapse. A nonzero value of η , the learning rate parameter, signals a plastic connection that changes according to the a modified BCM rule with parameters k_1 and k_2 . An explanation of neural area abbreviations can be found in the SI Text and in Fig. 2.

Projection	Arbor	P	$c_{ij}(0)$	Type	ϕ	η	k_1	k_2
<i>Red</i> $\rightarrow V_R$	\square 1 x 1	1.0000	0.0120,0.0140	VI	1.0000	0.0000	0.0000	0.0000
$V_R \rightarrow V_R$	\square 2 x 2	0.4000	0.5000,0.6000	VD	1.0000	0.0000	0.0000	0.0000
<i>Green</i> $\rightarrow V_G$	\square 1 x 1	1.0000	0.0120,0.0140	VI	1.0000	0.0000	0.0000	0.0000
$V_G \rightarrow V_G$	\square 2 x 2	0.4000	0.5000,0.6000	VD	1.0000	0.0000	0.0000	0.0000
<i>Blue</i> $\rightarrow V_B$	\square 1 x 1	1.0000	0.0120,0.0140	VI	1.0000	0.0000	0.0000	0.0000
$V_B \rightarrow V_B$	\square 2 x 2	0.4000	0.5000,0.6000	VD	1.0000	0.0000	0.0000	0.0000
<i>Yellow</i> $\rightarrow V_Y$	\square 1 x 1	1.0000	0.0120,0.0140	VI	1.0000	0.0000	0.0000	0.0000
$V_Y \rightarrow V_Y$	\square 2 x 2	0.4000	0.5000,0.6000	VD	1.0000	0.0000	0.0000	0.0000
<i>Wid2</i> $\rightarrow V_{W2}$	\square 1 x 1	1.0000	0.0080,0.0090	VI	1.0000	0.0000	0.0000	0.0000
$V_{W2} \rightarrow V_{W2}$	\square 1 x 1	0.4000	0.5000,0.6000	VD	1.0000	0.0000	0.0000	0.0000
<i>Wid4</i> $\rightarrow V_{W4}$	\square 1 x 1	1.0000	0.0080,0.0090	VI	1.0000	0.0000	0.0000	0.0000
$V_{W4} \rightarrow V_{W4}$	\square 1 x 1	0.4000	0.5000,0.6000	VD	1.0000	0.0000	0.0000	0.0000
<i>Wid16</i> $\rightarrow V_{W16}$	\square 1 x 1	1.0000	0.0080,0.0090	VI	1.0000	0.0000	0.0000	0.0000
$V_{W16} \rightarrow V_{W16}$	\square 1 x 1	0.4000	0.5000,0.6000	VD	1.0000	0.0000	0.0000	0.0000
<i>Wid8</i> $\rightarrow V_{W8}$	\square 1 x 1	1.0000	0.0080,0.0090	VI	1.0000	0.0000	0.0000	0.0000
$V_{W8} \rightarrow V_{W8}$	\square 1 x 1	0.4000	0.5000,0.6000	VD	1.0000	0.0000	0.0000	0.0000
$V_{W2} \rightarrow V_{W4}$	\square 2 x 2	1.0000	-0.0120,-0.0140	VI	1.0000	0.0000	0.0000	0.0000
$V_{W2} \rightarrow V_{W16}$	\square 2 x 2	1.0000	-0.0120,-0.0140	VI	1.0000	0.0000	0.0000	0.0000
$V_{W2} \rightarrow V_{W8}$	\square 2 x 2	1.0000	-0.0120,-0.0140	VI	1.0000	0.0000	0.0000	0.0000
$V_{W4} \rightarrow V_{W2}$	\square 2 x 2	1.0000	-0.0120,-0.0140	VI	1.0000	0.0000	0.0000	0.0000
$V_{W4} \rightarrow V_{W16}$	\square 2 x 2	1.0000	-0.0120,-0.0140	VI	1.0000	0.0000	0.0000	0.0000
$V_{W4} \rightarrow V_{W8}$	\square 2 x 2	1.0000	-0.0120,-0.0140	VI	1.0000	0.0000	0.0000	0.0000
$V_{W16} \rightarrow V_{W2}$	\square 2 x 2	1.0000	-0.0120,-0.0140	VI	1.0000	0.0000	0.0000	0.0000
$V_{W16} \rightarrow V_{W4}$	\square 2 x 2	1.0000	-0.0120,-0.0140	VI	1.0000	0.0000	0.0000	0.0000
$V_{W16} \rightarrow V_{W8}$	\square 2 x 2	1.0000	-0.0120,-0.0140	VI	1.0000	0.0000	0.0000	0.0000
$V_{W8} \rightarrow V_{W2}$	\square 2 x 2	1.0000	-0.0120,-0.0140	VI	1.0000	0.0000	0.0000	0.0000
$V_{W8} \rightarrow V_{W4}$	\square 2 x 2	1.0000	-0.0120,-0.0140	VI	1.0000	0.0000	0.0000	0.0000
$V_{W8} \rightarrow V_{W16}$	\square 2 x 2	1.0000	-0.0120,-0.0140	VI	1.0000	0.0000	0.0000	0.0000
$V_R \rightarrow IT$	nontopo	0.0500	0.0100,0.0400	VI	1.0000	0.0000	0.0000	0.0000
$V_G \rightarrow IT$	nontopo	0.0500	0.0100,0.0400	VI	1.0000	0.0000	0.0000	0.0000
$V_B \rightarrow IT$	nontopo	0.0500	0.0100,0.0400	VI	1.0000	0.0000	0.0000	0.0000
$V_Y \rightarrow IT$	nontopo	0.0500	0.0100,0.0400	VI	1.0000	0.0000	0.0000	0.0000

Projection	Arbor	p	$c_{ij}(0)$	Type	ϕ	η	k_1	k_2
$IT \rightarrow IT$	$\square 1 \times 1$	1.0000	0.0800,0.1400	VI	1.0000	0.0000	0.0000	0.0000
$IT \rightarrow IT_i$	$\Theta 2 \times 3$	1.0000	0.0600,0.0800	VI	1.0000	0.0000	0.0000	0.0000
$IT_i \rightarrow IT$	$\square 1 \times 1$	1.0000	-0.3600,-0.5000	VI	1.0000	0.0000	0.0000	0.0000
$V_{W2} \rightarrow PR$	$\square 1 \times 1$	0.2500	0.2500,0.3000	VI	1.0000	0.0000	0.0000	0.0000
$V_{W4} \rightarrow PR$	$\square 1 \times 1$	0.2500	0.2500,0.3000	VI	1.0000	0.0000	0.0000	0.0000
$V_{W16} \rightarrow PR$	$\square 1 \times 1$	0.2500	0.2500,0.3000	VI	1.0000	0.0000	0.0000	0.0000
$V_{W8} \rightarrow PR$	$\square 1 \times 1$	0.2500	0.2500,0.3000	VI	1.0000	0.0000	0.0000	0.0000
$PR \rightarrow PR$	$\Theta 4 \times 6$	1.0000	-0.0600,-0.0800	VI	1.0000	0.0000	0.0000	0.0000
$HD \rightarrow ATN$	$\square 30 \times 2$	0.2000	0.0100,0.0200	VI	1.0000	0.0000	0.0000	0.0000
$HD \rightarrow M_{Hdg}$	$\square 1 \times 1$	1.0000	0.0100,0.0100	VI	1.0000	0.0000	0.0000	0.0000
$ATN \rightarrow ATN_i$	$\square 10 \times 15$	0.2500	0.0100,0.0200	VI	1.0000	0.0000	0.0000	0.0000
$ATN_i \rightarrow ATN$	$\square 1 \times 1$	1.0000	-0.3600,-0.5000	VI	1.0000	0.0000	0.0000	0.0000
$M_{Hdg} \rightarrow M_{Hdg}$	$\square 1 \times 1$	1.0000	0.0600,0.0800	VI	1.0000	0.0000	0.0000	0.0000
$M_{Hdg} \rightarrow M_{Hdgi}$	$\square 20 \times 30$	0.5000	0.1000,0.2000	VI	1.0000	0.0000	0.0000	0.0000
$M_{Hdgi} \rightarrow M_{Hdg}$	$\square 1 \times 1$	1.0000	-0.3600,-0.5000	VI	1.0000	0.0000	0.0000	0.0000
$T+ \rightarrow S$	nontopo	1.0000	0.2500,0.2500	VI	1.0000	0.0000	0.0000	0.0000
$S \rightarrow CA1$	nontopo	1.0000	0.0010,0.0020	VD	1.0000	0.0000	0.0000	0.0000
$S \rightarrow ATN$	nontopo	1.0000	0.0010,0.0020	VD	1.0000	0.0000	0.0000	0.0000
$S \rightarrow IT$	nontopo	1.0000	0.0010,0.0020	VD	1.0000	0.0000	0.0000	0.0000
$S \rightarrow PR$	nontopo	1.0000	0.0010,0.0020	VD	1.0000	0.0000	0.0000	0.0000
$S \rightarrow M_{Hdg}$	nontopo	1.0000	0.0500,0.0600	VD	1.0000	0.0000	0.0000	0.0000
$IT \rightarrow ECIN$	nontopo	0.0007	0.4000,0.5000	VI	1.0000	0.0000	0.0000	0.0000
$PR \rightarrow ECIN$	nontopo	0.0007	0.4000,0.5000	VI	1.0000	0.0000	0.0000	0.0000
$ATN \rightarrow ECIN$	nontopo	0.0007	0.2000,0.2500	VI	1.0000	0.0000	0.0000	0.0000
$SMAP \rightarrow ECIN$	nontopo	0.0007	0.2000,0.2500	VI	1.0000	0.0000	0.0000	0.0000
$SII \rightarrow ECIN$	nontopo	0.0007	0.2000,0.2500	VI	1.0000	0.0000	0.0000	0.0000
$ECOUT \rightarrow IT$	nontopo	0.0100	0.4000,0.4500	VD	1.0000	0.0000	0.0000	0.0000
$ECOUT \rightarrow PR$	nontopo	0.0100	0.4000,0.4500	VD	1.0000	0.0000	0.0000	0.0000
$ECOUT \rightarrow ATN$	nontopo	0.0100	0.4000,0.4500	VD	1.0000	0.0000	0.0000	0.0000
$ECOUT \rightarrow SMAP$	nontopo	0.0100	0.4000,0.4500	VD	1.0000	0.0000	0.0000	0.0000
$ECOUT \rightarrow SII$	nontopo	0.0100	0.4000,0.4500	VD	1.0000	0.0000	0.0000	0.0000
$ECIN \rightarrow ECIN_{ifb}$	$\Theta 2 \times 3$	0.1000	0.4500,0.6000	VI	1.0000	0.0000	0.0000	0.0000
$ECIN_{ifb} \rightarrow ECIN$	$\square 1 \times 1$	1.0000	-0.9000,-1.2000	VI	1.0000	0.0000	0.0000	0.0000
$ECOUT \rightarrow ECOUT_{ifb}$	$\Theta 2 \times 3$	0.1000	0.4500,0.6000	VI	1.0000	0.0000	0.0000	0.0000
$ECOUT_{ifb} \rightarrow ECOUT$	$\square 1 \times 1$	1.0000	-0.9000,-1.2000	VI	1.0000	0.0000	0.0000	0.0000
$DG \rightarrow DG$	$\square 1 \times 1$	1.0000	0.1000,0.1400	VI	1.0000	0.0000	0.0000	0.0000
$DG \rightarrow DG_{ifb}$	$\Theta 2 \times 3$	0.1000	0.4500,0.6000	VI	1.0000	0.0000	0.0000	0.0000
$DG_{ifb} \rightarrow DG$	$\square 1 \times 1$	1.0000	-0.9000,-1.2000	VI	1.0000	0.0000	0.0000	0.0000
$CA3 \rightarrow CA3_{ifb}$	$\Theta 2 \times 3$	0.1000	0.4500,0.6000	VI	1.0000	0.0000	0.0000	0.0000
$CA3_{ifb} \rightarrow CA3$	$\square 1 \times 1$	1.0000	-0.9000,-1.2000	VI	1.0000	0.0000	0.0000	0.0000
$CA1 \rightarrow CA1_{ifb}$	$\Theta 2 \times 3$	0.1000	0.4500,0.6000	VI	1.0000	0.0000	0.0000	0.0000
$CA1_{ifb} \rightarrow CA1$	$\square 1 \times 1$	1.0000	-0.9000,-1.2000	VI	1.0000	0.0000	0.0000	0.0000
$DG \rightarrow CA3_{iff}$	$\Theta 2 \times 3$	0.1000	0.4500,0.6000	VI	1.0000	0.0000	0.0000	0.0000
$CA3_{iff} \rightarrow CA3$	$\square 1 \times 1$	1.0000	-0.9000,-1.2000	VI	1.0000	0.0000	0.0000	0.0000
$CA3 \rightarrow CA1_{iff}$	$\Theta 2 \times 3$	0.1000	0.4500,0.6000	VI	1.0000	0.0000	0.0000	0.0000

Projection	Arbor	p	$c_{ij}(0)$	Type	ϕ	η	k_1	k_2
$CA1_{iff} \rightarrow CA1$	$\square 1 \times 1$	1.0000	-0.9000,-1.2000	VI	1.0000	0.0000	0.0000	0.0000
$BFECIN \rightarrow ECIN$	nontopo	0.0500	-0.0100,-0.0200	VI	1.0000	0.0000	0.0000	0.0000
$BFECOUT \rightarrow ECOUT$	nontopo	0.0500	-0.0100,-0.0200	VI	1.0000	0.0000	0.0000	0.0000
$BFDG \rightarrow DG$	nontopo	0.0500	-0.0100,-0.0200	VI	1.0000	0.0000	0.0000	0.0000
$BFCA3 \rightarrow CA3$	nontopo	0.0500	-0.0100,-0.0200	VI	1.0000	0.0000	0.0000	0.0000
$BFCA1 \rightarrow CA1$	nontopo	0.0500	-0.0100,-0.0200	VI	1.0000	0.0000	0.0000	0.0000
$WLLT \rightarrow SILT$	$\square 0 \times 0$	1.0000	0.6000,0.7500	VI	1.0000	0.0000	0.0000	0.0000
$WLLM \rightarrow SILM$	$\square 0 \times 0$	1.0000	0.6000,0.7500	VI	1.0000	0.0000	0.0000	0.0000
$WRLT \rightarrow SIRT$	$\square 0 \times 0$	1.0000	0.6000,0.7500	VI	1.0000	0.0000	0.0000	0.0000
$WRLM \rightarrow SIRM$	$\square 0 \times 0$	1.0000	0.6000,0.7500	VI	1.0000	0.0000	0.0000	0.0000
$SILT \rightarrow SILT$	$\Theta 2 \times 8$	1.0000	-0.4500,-0.6000	VI	1.0000	0.0000	0.0000	0.0000
$SILM \rightarrow SILM$	$\Theta 2 \times 8$	1.0000	-0.4500,-0.6000	VI	1.0000	0.0000	0.0000	0.0000
$SIRT \rightarrow SIRT$	$\Theta 2 \times 8$	1.0000	-0.4500,-0.6000	VI	1.0000	0.0000	0.0000	0.0000
$SIRM \rightarrow SIRM$	$\Theta 2 \times 8$	1.0000	-0.4500,-0.6000	VI	1.0000	0.0000	0.0000	0.0000
$SILT \rightarrow SII$	S2special	0.0350	0.2500,0.2500	VI	1.0000	0.0000	0.4500	0.4500
$SILM \rightarrow SII$	S2special	0.0350	0.2500,0.2500	VI	1.0000	0.0000	0.4500	0.4500
$SIRT \rightarrow SII$	S2special	0.0350	0.2500,0.2500	VI	1.0000	0.0000	0.4500	0.4500
$SIRM \rightarrow SII$	S2special	0.0350	0.2500,0.2500	VI	1.0000	0.0000	0.4500	0.4500
$ECIN \rightarrow ECOUT$	nontopo	0.0500	0.0400,0.0800	VI	1.0000	0.0000	0.0000	0.0000
$ECOUT \rightarrow ECIN$	nontopo	0.0500	0.0400,0.0800	VI	1.0000	0.0000	0.0000	0.0000
$IT \rightarrow PR$	nontopo	0.0050	0.0100,0.0200	VI	1.0000	0.0000	0.4500	0.4500
$IT \rightarrow ATN$	nontopo	0.0050	0.0100,0.0200	VI	1.0000	0.0000	0.4500	0.4500
$PR \rightarrow IT$	nontopo	0.0050	0.0100,0.0200	VI	1.0000	0.0000	0.4500	0.4500
$PR \rightarrow ATN$	nontopo	0.0050	0.0100,0.0200	VI	1.0000	0.0000	0.4500	0.4500
$ATN \rightarrow PR$	nontopo	0.0050	0.0100,0.0200	VI	1.0000	0.0000	0.4500	0.4500
$ATN \rightarrow IT$	nontopo	0.0050	0.0100,0.0200	VI	1.0000	0.0000	0.4500	0.4500
$ECIN \rightarrow DG$	$\square 3 \times 3$	0.1000	0.4500,0.6000	VI	0.2500	0.0500	0.9000	0.4500
$ECIN \rightarrow CA3$	$\square 3 \times 3$	0.0500	0.1500,0.2000	VI	0.2500	0.0500	0.9000	0.4500
$ECIN \rightarrow CA1$	$\square 3 \times 3$	0.0400	0.3000,0.4000	VI	0.2500	0.0500	0.9000	0.4500
$DG \rightarrow CA3$	$\square 3 \times 3$	0.0300	0.4500,0.6000	VI	0.2500	0.0500	0.9000	0.4500
$CA3 \rightarrow CA3$	nontopo	0.1000	0.1500,0.2000	VI	0.2500	0.0500	0.9000	0.4500
$CA3 \rightarrow CA1$	$\square 3 \times 3$	0.0800	0.4500,0.6000	VI	0.2500	0.0500	0.9000	0.4500
$CA1 \rightarrow ECOUT$	$\square 3 \times 3$	0.2500	0.6000,0.7500	VI	0.2500	0.0500	0.9000	0.4500
$CA1 \rightarrow S$	nontopo	1.0000	0.0100,0.0200	VI	1.0000	0.0050	0.9000	0.4500
$CA1 \rightarrow M_{Hdg}$	nontopo	1.0000	0.0100,0.0200	VD	1.0000	0.0500	0.9000	0.4500