

mcfeedback — Iteration 7: Connectivity Diagnostic

experiment-007.mjs · No mechanism changes — structural analysis only · N = 10 seeds · Config: experiment-004 base (flag gate + linear reward)

Key finding: the failure mode is not structural.

No pre-training connectivity metric correlates meaningfully with final accuracy. Direct I→O connections differ by only 1.4 on average between good and poor seeds (13.6 vs 12.2). Chemical dose budget and modulatory distance to outputs are essentially identical across groups. 2-hop path counts are nearly the same (344 vs 349 — poor seeds are *marginally higher*). The network graph is not the bottleneck.

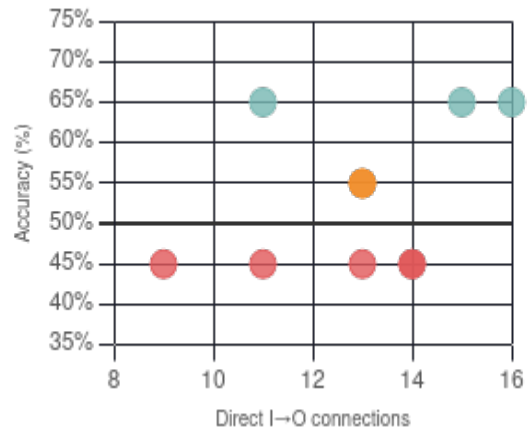
The 7-seed stall is a dynamical problem — it emerges from early training trajectories, not from wiring.

65% accuracy

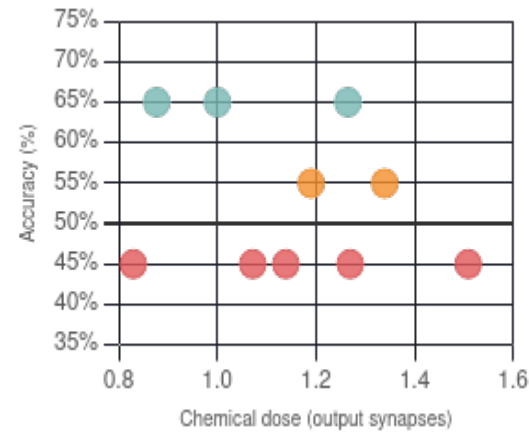
55% accuracy

45% accuracy

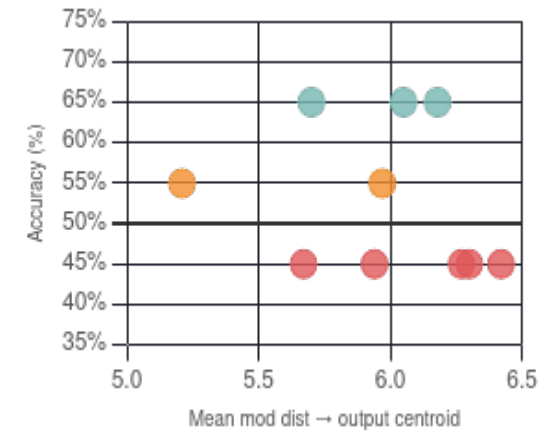
1 — SCATTER: STRUCTURAL METRICS VS FINAL ACCURACY

Direct I→O connections

Max possible: 25. Range: 9–16. No separation between groups.

Chemical dose (output-bound synapses)

Sum of 1/distance from all 4 mod neurons. Good seeds actually trend lower.

Mean modulatory distance to outputs

Closer mod neurons → stronger chemical signal. No clear pattern.

2 — FULL PER-SEED DATA

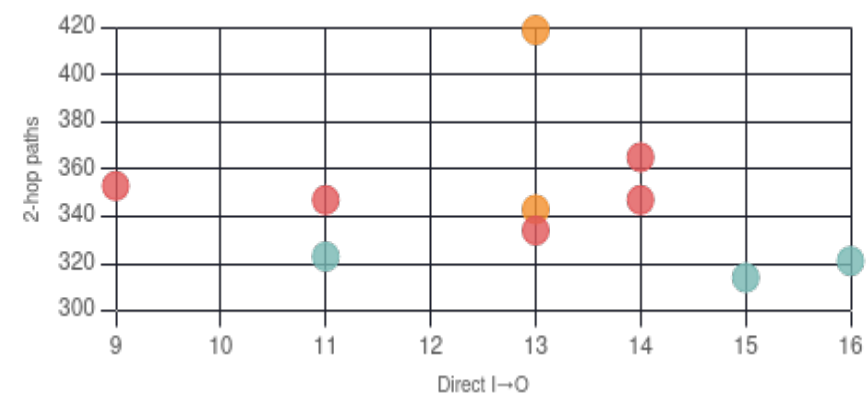
| Seed | Acc% | Direct I→O | 2-hop paths | Input fan-out | Output fan-in | Chem dose | Mod dist→out | Total synapses |
|------|------|------------|-------------|---------------|---------------|-----------|--------------|----------------|
| 888 | 65% | 15 | 314 | 29.8 | 31.0 | 1.000 | 6.18 | 1676 |
| 999 | 65% | 11 | 323 | 28.0 | 30.2 | 0.877 | 6.05 | 1648 |
| 1234 | 65% | 16 | 321 | 30.0 | 30.0 | 1.265 | 5.70 | 1667 |
| 618 | 55% | 13 | 419 | 31.8 | 34.2 | 1.339 | 5.21 | 1693 |
| 777 | 55% | 13 | 343 | 27.0 | 33.6 | 1.190 | 5.97 | 1718 |
| 42 | 45% | 13 | 334 | 27.4 | 32.4 | 1.072 | 5.67 | 1648 |

| | | | | | | | | |
|-----|-----|----|-----|------|------|-------|------|------|
| 137 | 45% | 14 | 347 | 30.0 | 33.2 | 1.509 | 5.94 | 1658 |
| 271 | 45% | 14 | 365 | 31.0 | 31.4 | 1.270 | 6.42 | 1701 |
| 314 | 45% | 9 | 353 | 32.0 | 28.2 | 0.830 | 6.30 | 1681 |
| 500 | 45% | 11 | 347 | 29.4 | 30.6 | 1.139 | 6.27 | 1645 |

3 — GROUP COMPARISON: GOOD SEEDS ($\geq 55\%$) VS POOR SEEDS ($< 55\%$)

| Metric | Good ($\geq 55\%$, n=5) | Poor ($< 55\%$, n=5) | Delta |
|----------------------------|---------------------------|------------------------|-------|
| Direct I→O connections | 13.60 | 12.20 | +1.40 |
| 2-hop paths | 344.00 | 349.20 | -5.20 |
| Input fan-out (mean) | 29.32 | 29.96 | -0.64 |
| Output fan-in (mean) | 31.80 | 31.16 | +0.64 |
| Chemical dose (output) | 1.130 | 1.164 | -0.03 |
| Mod dist → output centroid | 5.82 | 6.12 | -0.30 |
| | | | |

2-hop paths vs Direct I→O (all seeds)



Neither axis separates good from poor. The clusters overlap completely.

What the null result rules out:

- × Insufficient direct input→output pathways
- × Too few 2-hop paths through hidden neurons
- × Weak chemical dose — poor seeds get equal or slightly more reward signal

- × Bad modulatory neuron positioning
- × Sparse fan-out or fan-in

What this implies about the actual bottleneck:

The failure is in the *early training dynamics*. The flag gate requires ~2 turns of consistent same-direction trace to unlock a synapse.

Whether a synapse sees consistent traces depends on which patterns fire together in the first 50–100 episodes — a function of threshold initialisation and the specific input patterns presented, not the graph topology.

Next diagnostic: log flag strength distributions at episodes 100, 300, and 500. If good seeds show flags already latched ($\text{flagStrength} \geq 0.5$) on output-bound synapses by episode 100 while poor seeds are still at ~0, the bottleneck is flag gate bootstrapping speed. Fix: lower `flagStrengthThreshold` or raise `flagStrengthGain` so weak early signals can still accumulate — or add a short warm-up phase with the gate disabled.