

A

Grounding = immigration

fresh verified samples from a fixed external source enter the training mix every generation

Recombination = sex

a child inherits from several parents, reassembling variants that arose in different lineages

Epistasis (entangled skills)

a variant's fitness contribution depends on the variants present at the other loci

The composed society

selection, recombination, diversity preservation and grounding on one population

Speciation

reproductive isolation: diverged lineages no longer produce viable (mergeable) offspring

Inheritance model (reference)

Wright-Fisher simulator (NumPy)

closed forms · sets the expectation



immigration-drift equilibrium:
 $g \approx 0.05$ retains $\geq 95\%$ diversity;
observation floor $1 - e^{-mp}$

Fig. 2B

blending conservation law
(first-order cancellation);
union-operator gain; Fisher-Muller

SI

reference values only: outbreeding
depression, the recombination-rate
optimum, mate-pool breadth (SI)

SI

four-arm ablation: grounding, sex,
diversity each removed
→ three distinct failures

Fig. 4D-F

BDM incompatibility model:
isolation cliff; quadratic snowball

Fig. 5E-F

Trained networks

RNN · MLP · VAE
on a synthetic oracle;
convolutional VAE on MNIST
sign-level tests · exact oracles



collapse & rescue in every
architecture; MNIST: dry 30 → 1 modes,
10% grounding holds 30/30;
estimator-bias learning kernel

Fig. 2A

merge rescues two forgetting
specialists ($\approx 0.50 \rightarrow 0.955$)

Table S2

adds no discriminating test
at this tier

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barrier decomposition under
permutation+rescaling; conflict
sweep 0.97 → 0.03; emergent null

Fig. 5A-B

Language models

LoRA specialists on Qwen
0.5B, 1.5B & 7B; exact-match
and execution verifiers
seed-replicated signs



established at LLM scale in
prior work (refs. 23, 33);
not re-run here

merged specialists beat every parent
(5 seeds at 0.5B; 7B); routing vs
averaging: the headroom rule

Fig. 3B-C

bred-and-screened offspring beat
the blind blend in every seed
(hard, unsaturated tasks)

Table S2

6 generations × 3 lineages:
obligate merging collapses,
a declinable merge tracks
partner complementarity

Fig. 4B-C

convention conflict → hybrid
breakdown; duration null; pre-merge
predictive test (13 cond. × 3 seeds)

Figs. 5C-D, 3D-E