

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

Biological model
Wright-Fisher simulator (NumPy)
closed forms · bitwise-reproducible

immigration-drift equilibrium:
 $g \approx 0.05$ retains $\geq 95\%$ diversity;
observation floor $1 - e^{-mp}$
Fig. 2A

blending conservation law
(first-order cancellation);
union-operator gain; Fisher-Muller
Fig. 4

NK landscapes: outbreeding
depression; directed sex restores
the gain; mate-pool breadth optimum
Fig. 5

four-arm ablation: grounding, sex,
diversity each removed
→ three distinct failures
Fig. 6

BDM incompatibility model:
isolation cliff; quadratic snowball
Fig. 7A-B

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. 2B

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. 7C-D

Language models
LoRA specialists on Qwen 0.5B & 7B;
exact-match verifier
seed-replicated signs

*established at LLM scale in
prior work (refs. 21, 30);
not re-run here*

merged specialists beat every parent
(5 seeds at 0.5B; 7B); routing vs
averaging: the headroom rule
Fig. 3A-B

bred-and-screened offspring beat
the blind blend in every seed
(hard, unsaturated tasks)
Table S2

open — the stated gap

convention conflict → hybrid
breakdown; duration null; pre-merge
predictive test (13 cond. × 3 seeds)
Figs. 7E-F, 3C-D