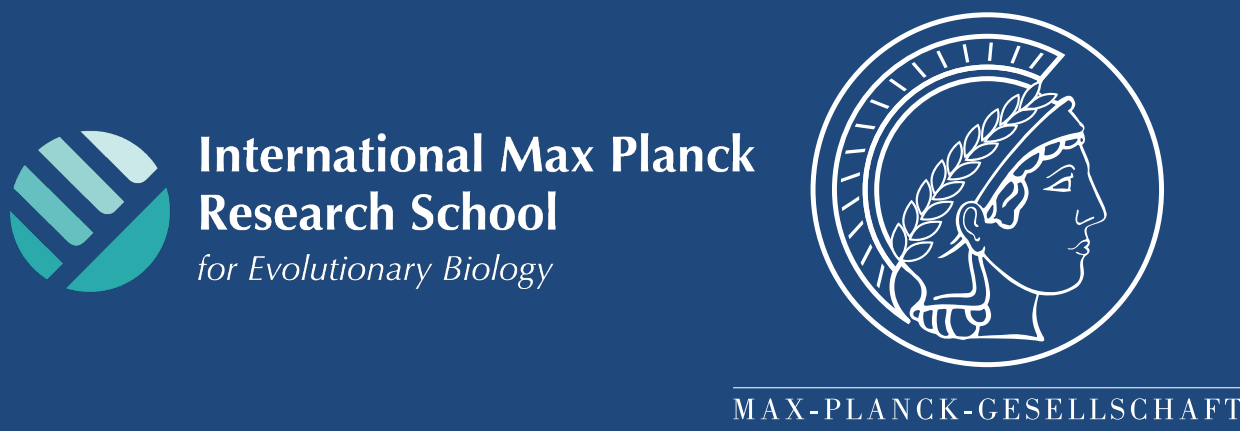


Being noisy in a crowd: Differential selective pressure on gene expression noise in model gene regulatory networks

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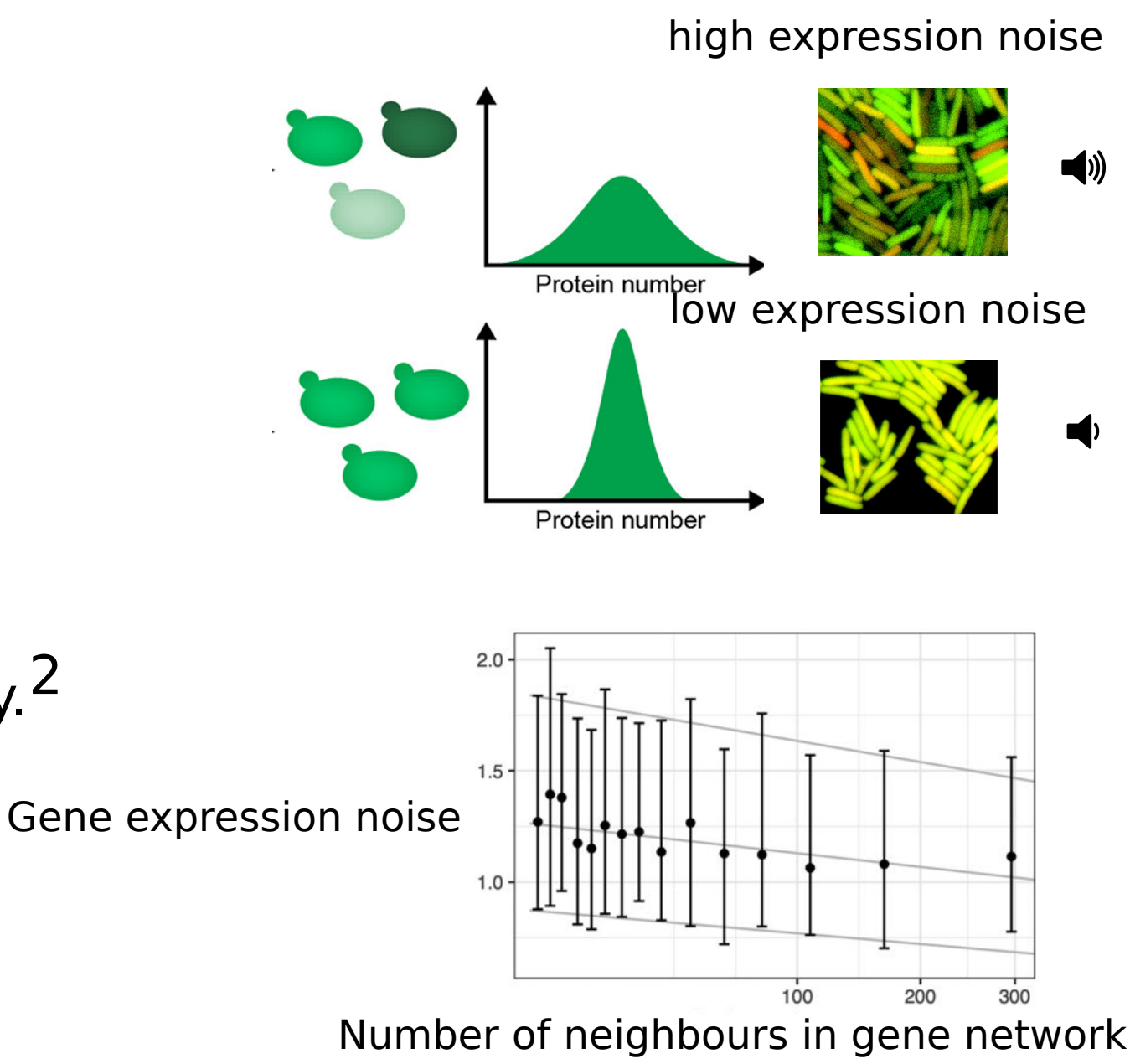
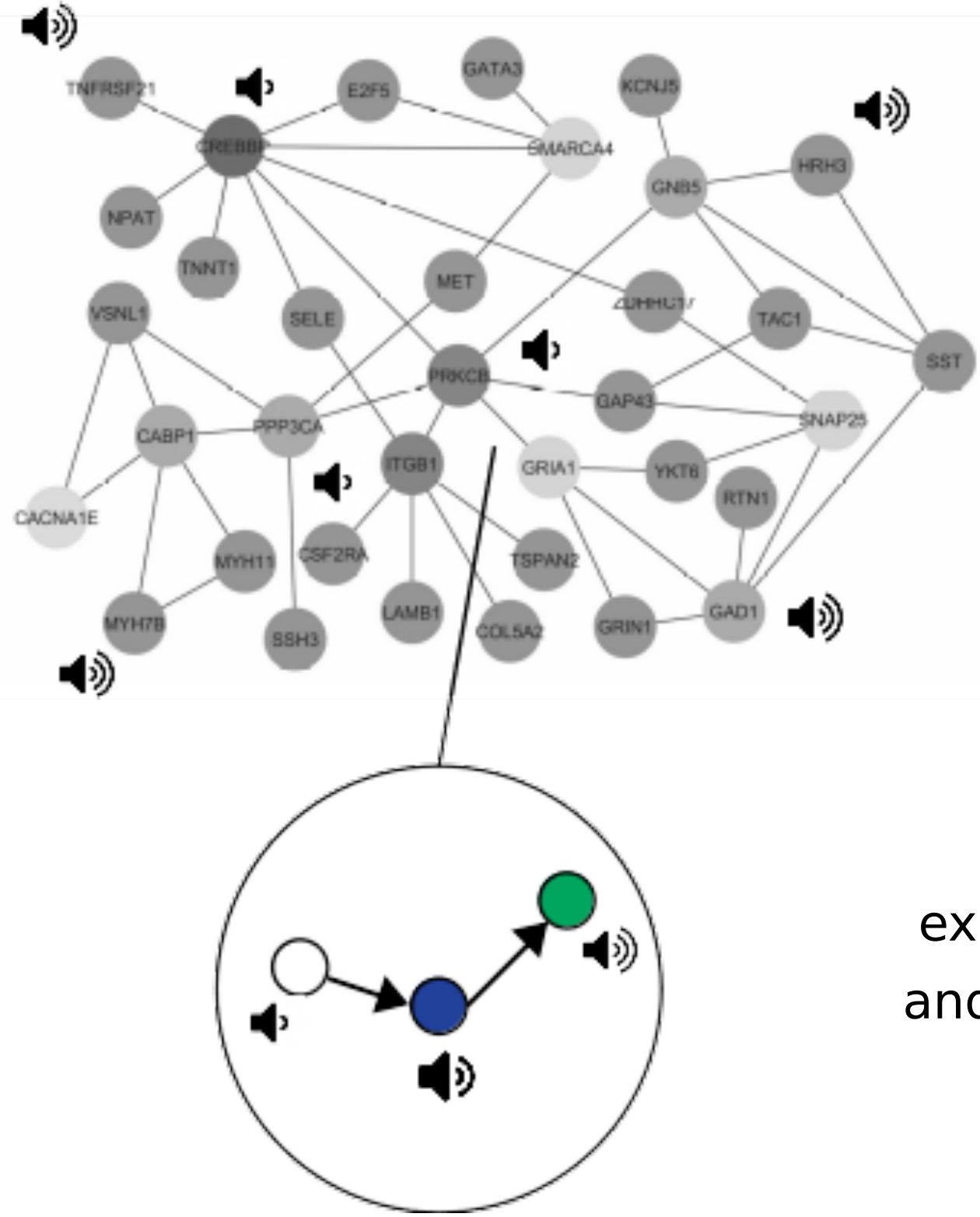


Background

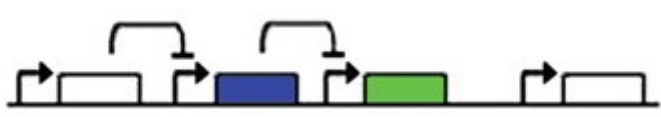
Gene expression is a stochastic process of diffusion and binding of molecules involved in transcription and translation.

Variation in the number of gene products due to stochasticity of gene expression is called expression noise. Gene-specific expression noise is an evolvable trait and is subject to natural selection.¹

Central genes in gene networks are less noisy.²



The expression noise of one gene can create noise in a neighbouring downstream gene.³
Thus, noise is propagated within the network.

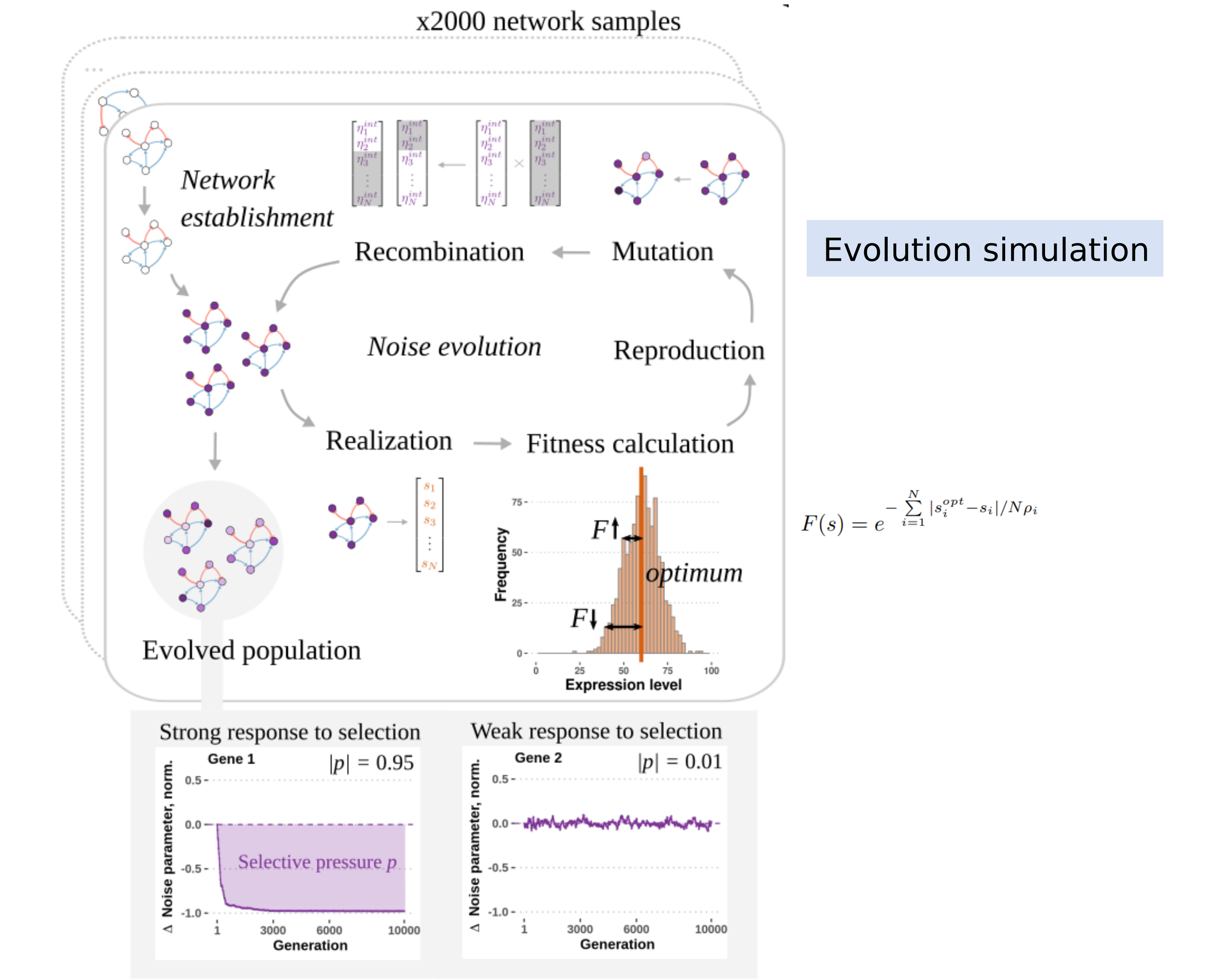
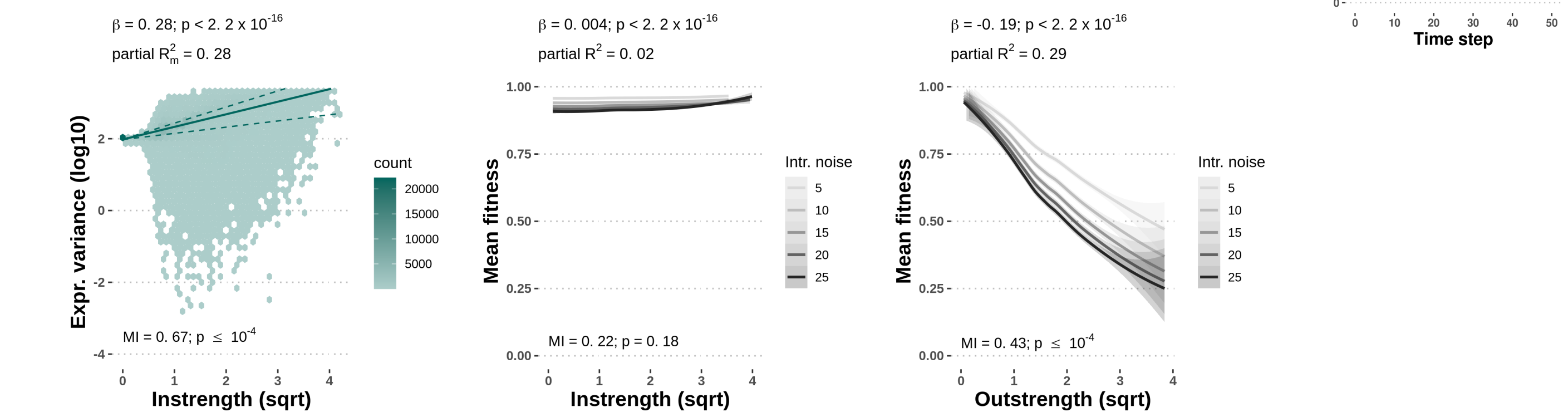
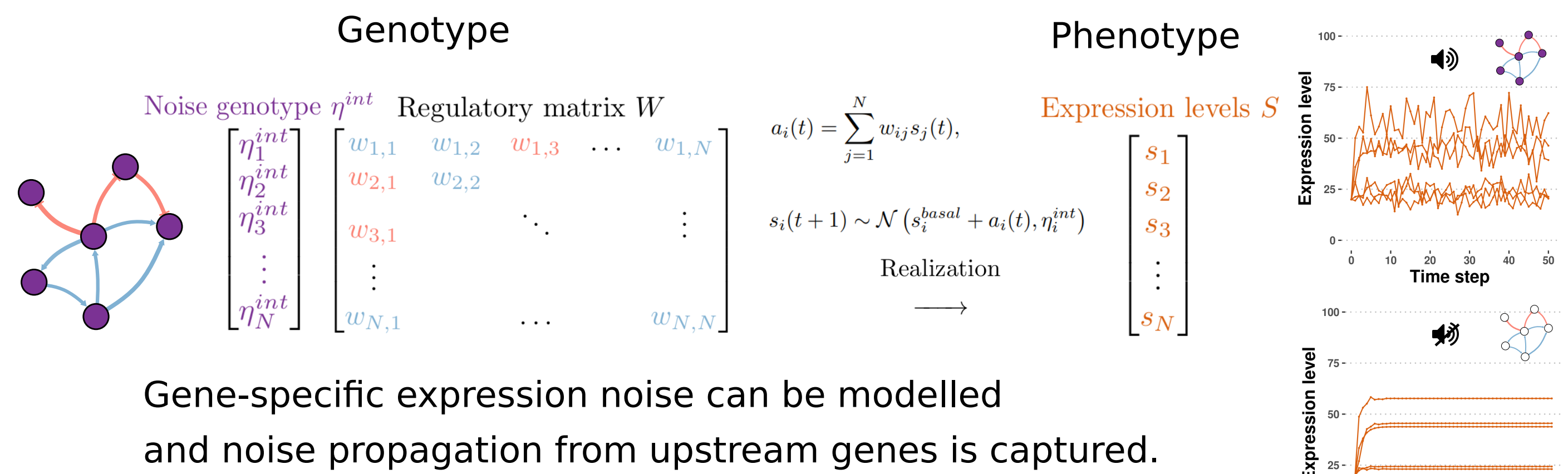


If a gene is under selective pressure for expression noise, the position it has in the network and its gene-specific noise both affect its evolution.

How does the network topology affect the evolution of the expression noise of genes in a gene regulatory network?

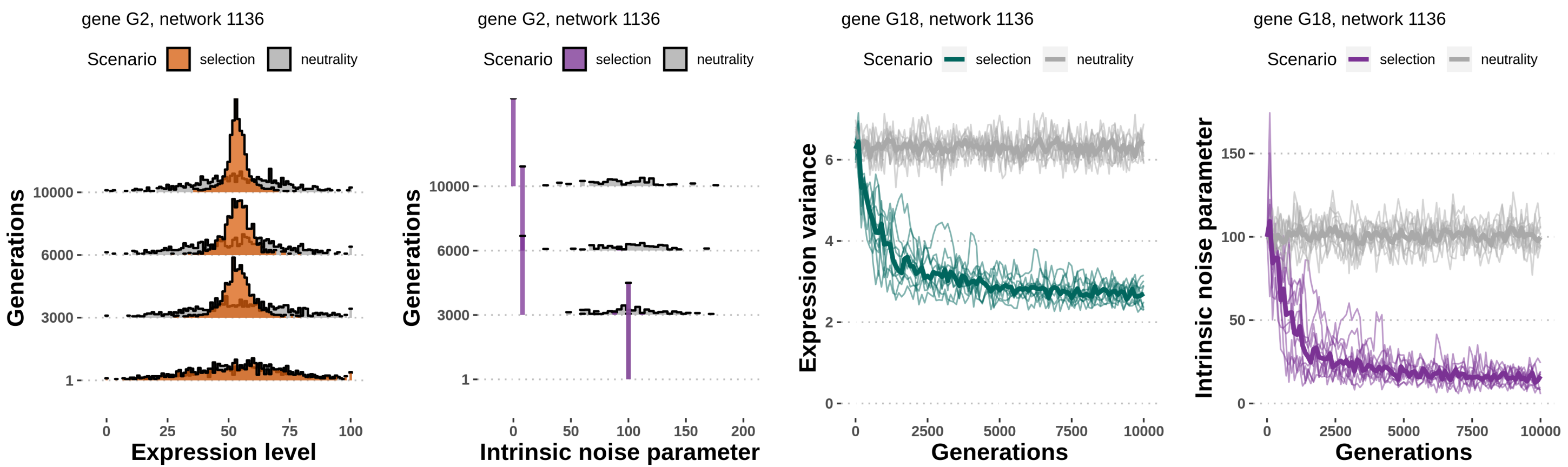
Method

Gene regulatory network model with stochastic gene expression

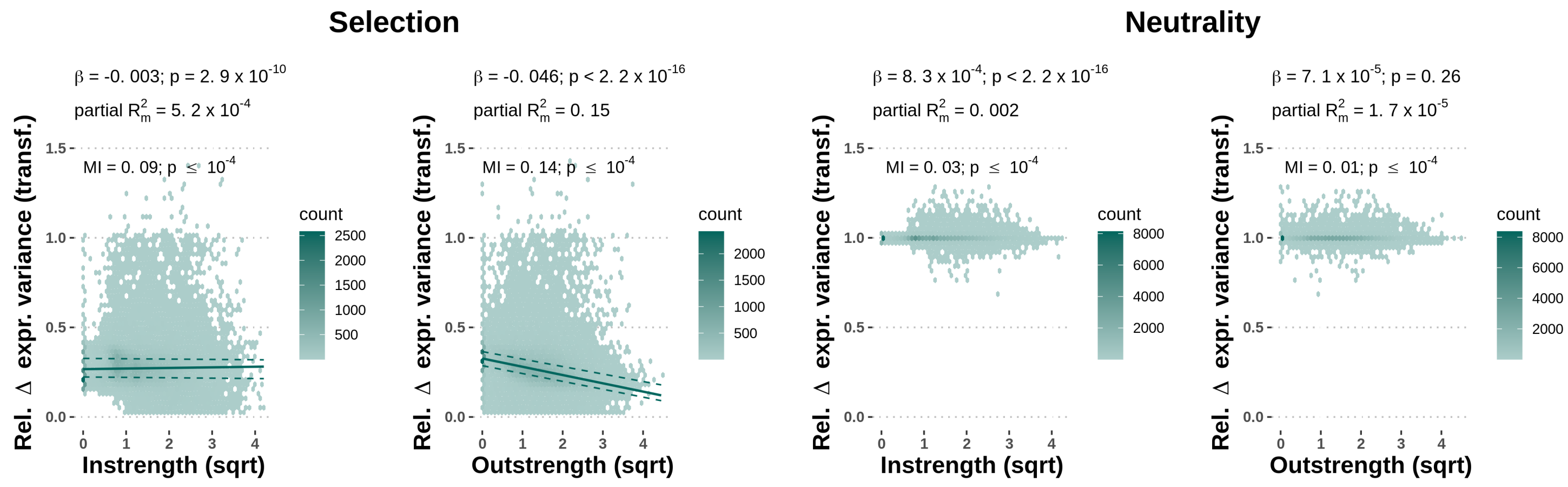


Results

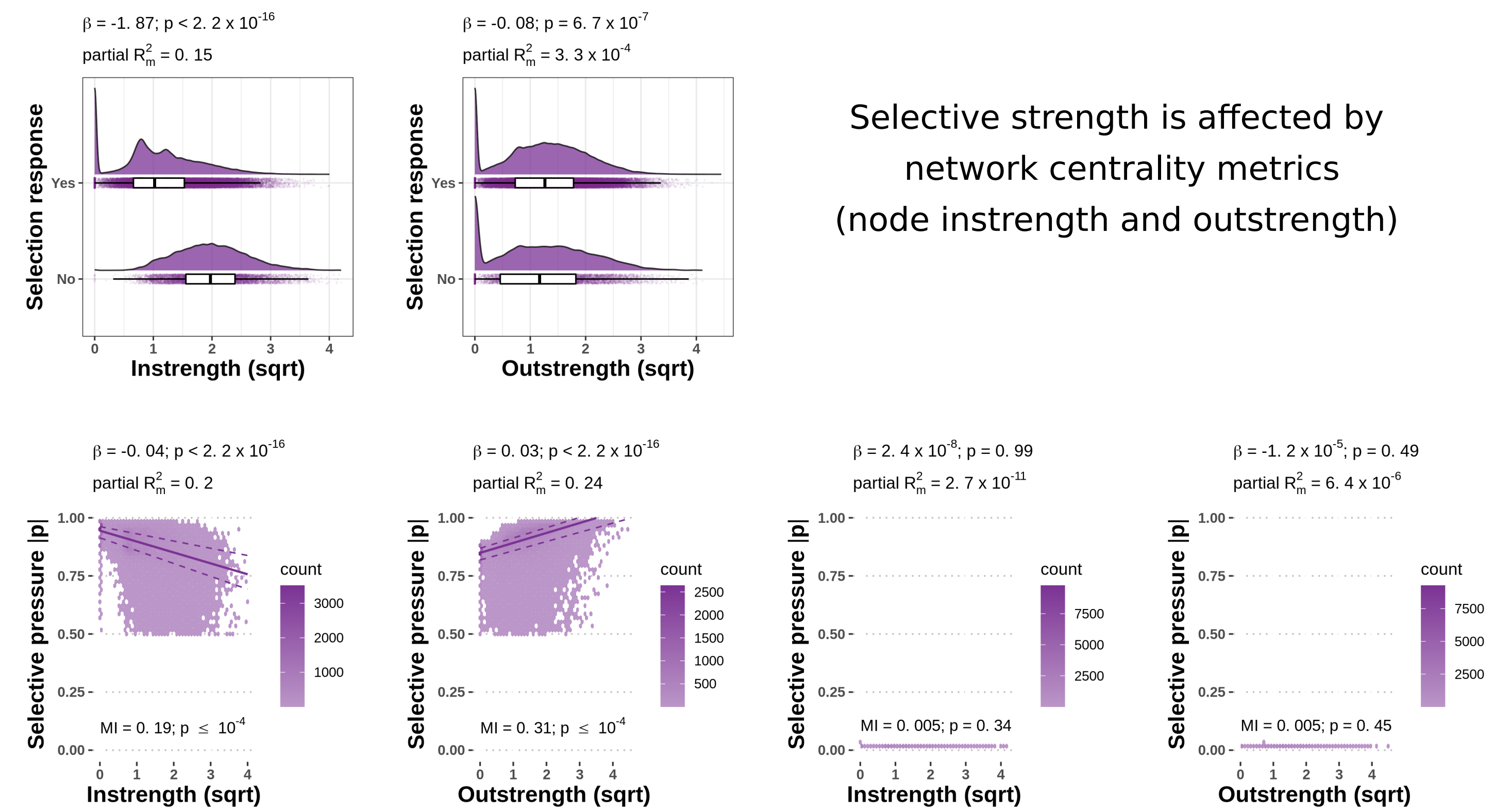
Stabilizing selection on gene expression level reduces gene-specific expression noise.



Evolutionary change in phenotypes: regulators reduce their expression noise to a higher degree.

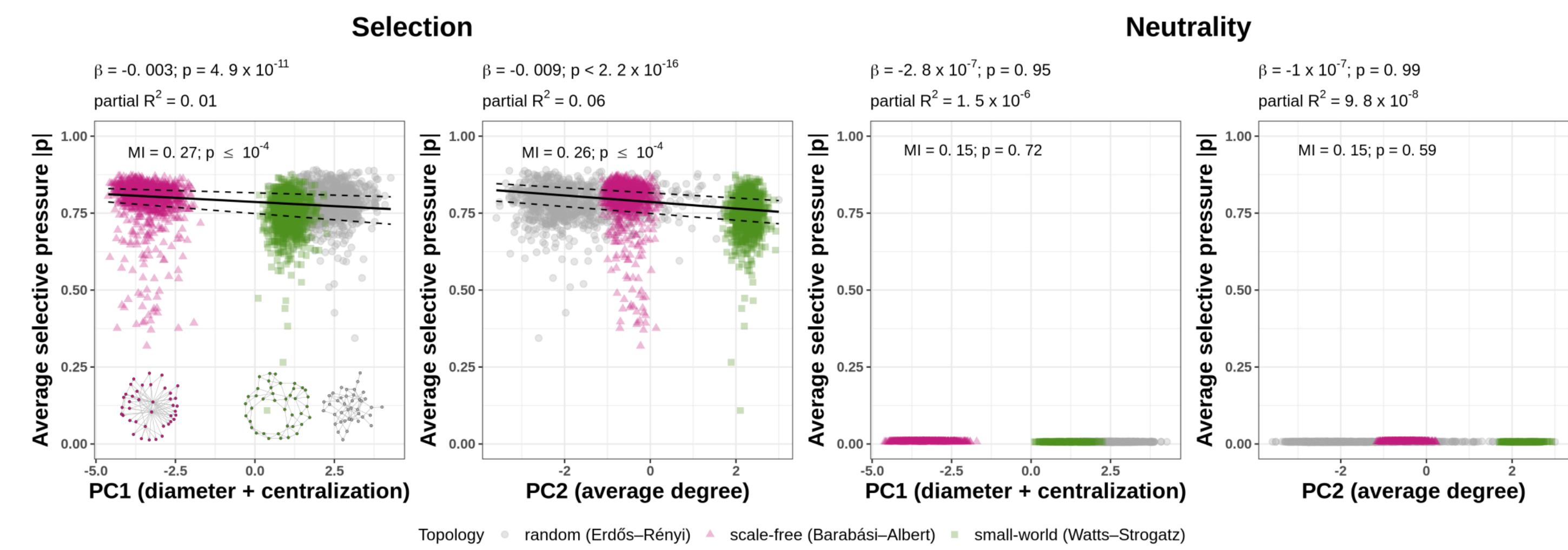


Evolutionary change in genotypes: regulators experience stronger selective pressure.



Selective strength is affected by network centrality metrics (node instrength and outstrength)

Global network properties affect the average selective pressure acting on gene expression noise.



Conclusion

The strength of selective pressure on gene-specific expression noise depends on the position of the gene in the network.

Regulators are under stronger selective pressure on gene-specific noise than regulated genes.

The global structure of the background network affects noise propagation and average selective pressure acting on genes..



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Barroso, G. V., N. Puzovic, and J. Y. Dutheil, 2018 The evolution of gene-specific transcriptional noise is driven by selection at the pathway level. Genetics 208: 173-189
Pedraza JM, van Oudenaarden A. Noise propagation in gene networks. Science. 2005;307(5717):1965-9..