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Phenotypic consequences of promoter-mediated transcriptional noise: Experiment and computational modeling GABOR BALAZSI, WILLIAM BLAKE, MICHAEL KOHANSKI, KEVIN MURPHY, JAMES COLLINS, Center for BioDynamics and Center for Advanced Biotechnology, Boston University, Boston, MA 02215, USA — A more complete understanding of the causes and effects of gene expression noise is needed to elucidate whether the resulting phenotypes are disadvantageous or confer some adaptive advantage. We introduce mutations within the promoter region of an engineered, repressible *Saccharomyces cerevisiae* GAL1 promoter to show that the level of gene expression noise is affected by the sequence of the TATA box. Through computer simulations, we identify transcription scaffold stability as a critical noise-mediating factor. We demonstrate that TATA box-dependent, increased gene expression noise can be beneficial after an acute change in environmental conditions. First, we illustrate computationally how a stable transcription scaffold can enable increased cell-cell variability at steady state. Second, we experimentally verify our computational prediction that the increased gene expression noise enabled by TATA-containing promoters confers a clear benefit in the face of an acute environmental stress.

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