Quantitative Microbial Physiology

Jacopo Grilli
Lecture 6, Feb 24, 2025

Model effect of antibiotics
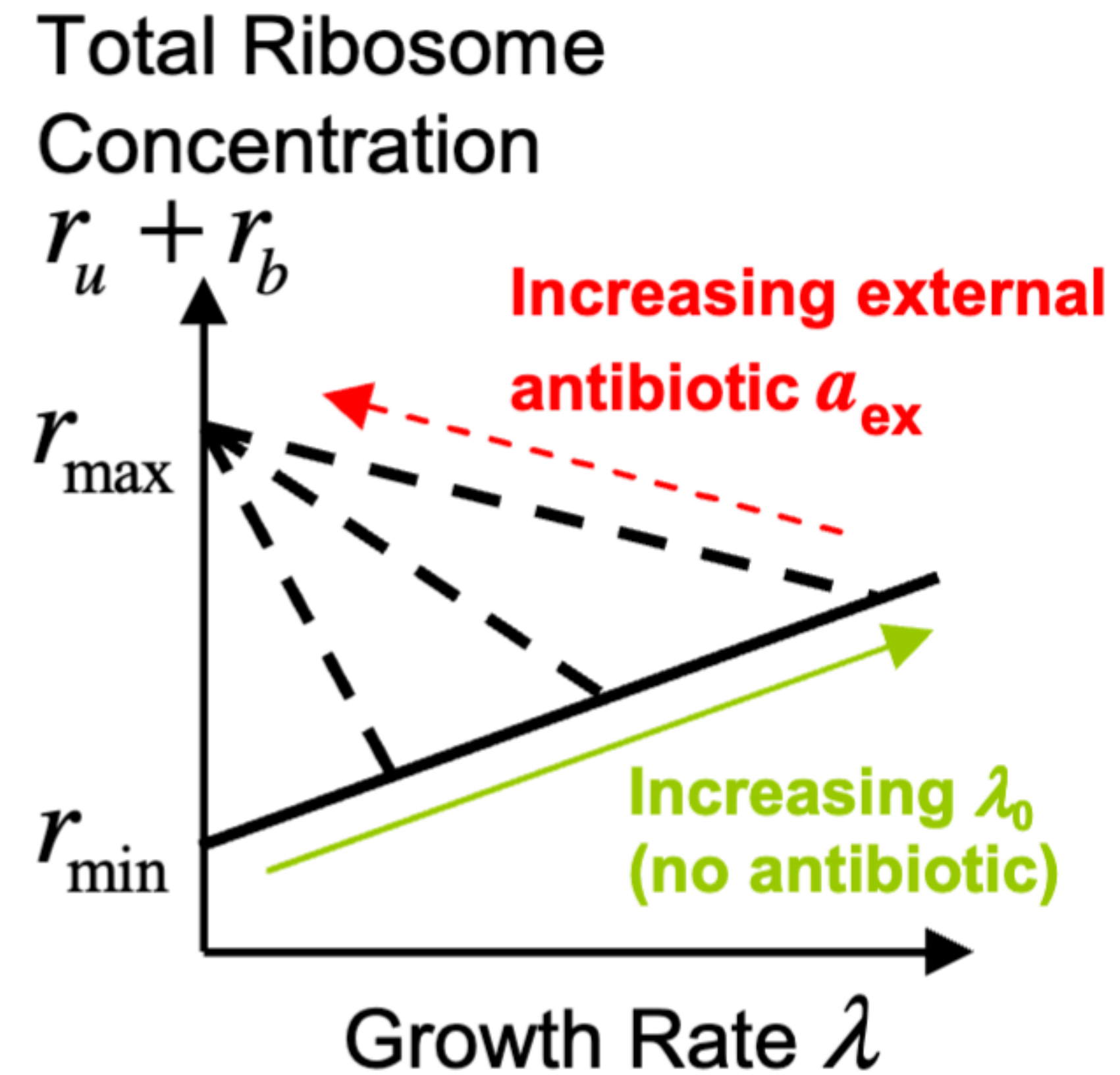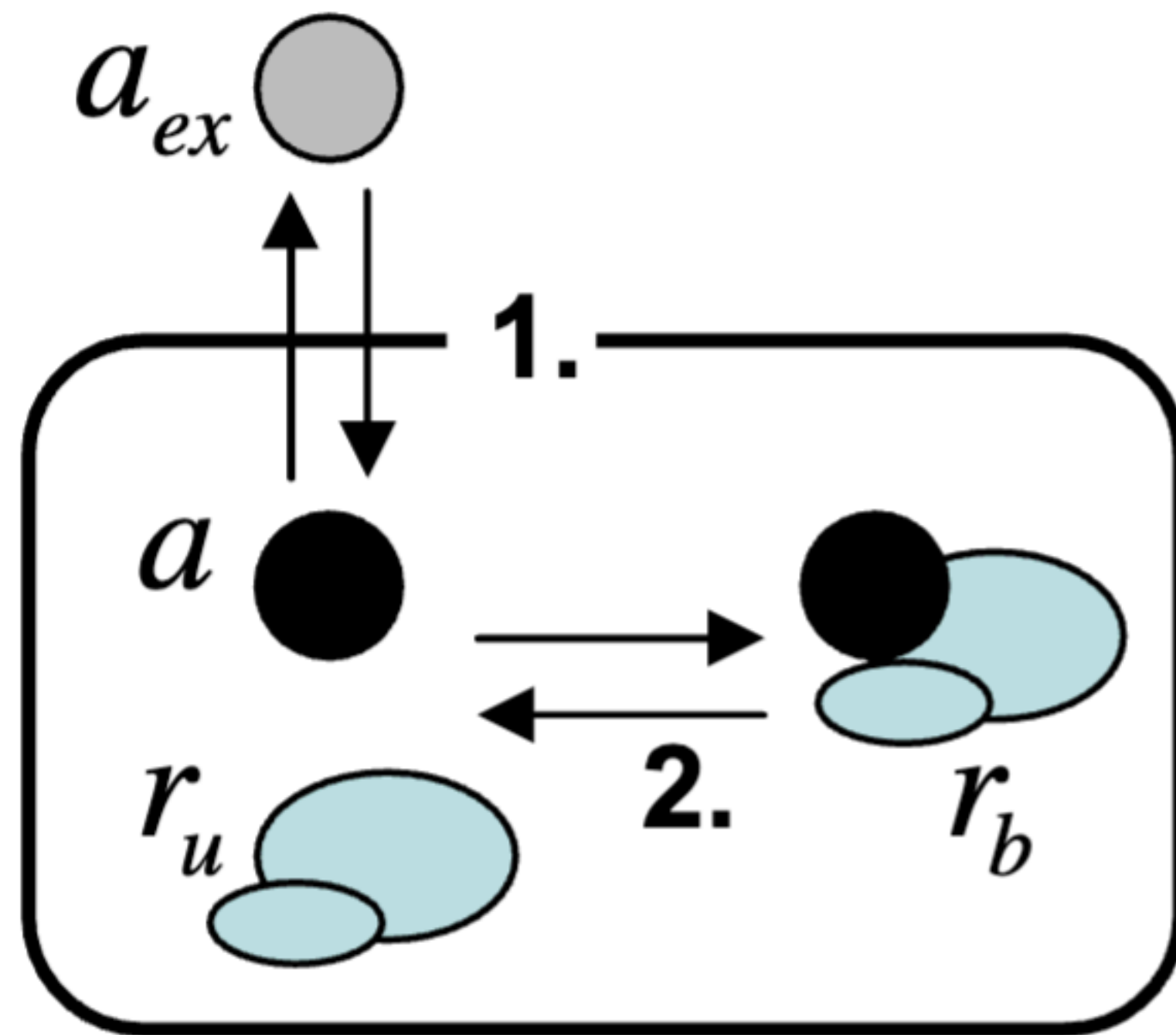
Greulich et. al (2015)

Model predicts the effect of antibiotics on growth rate
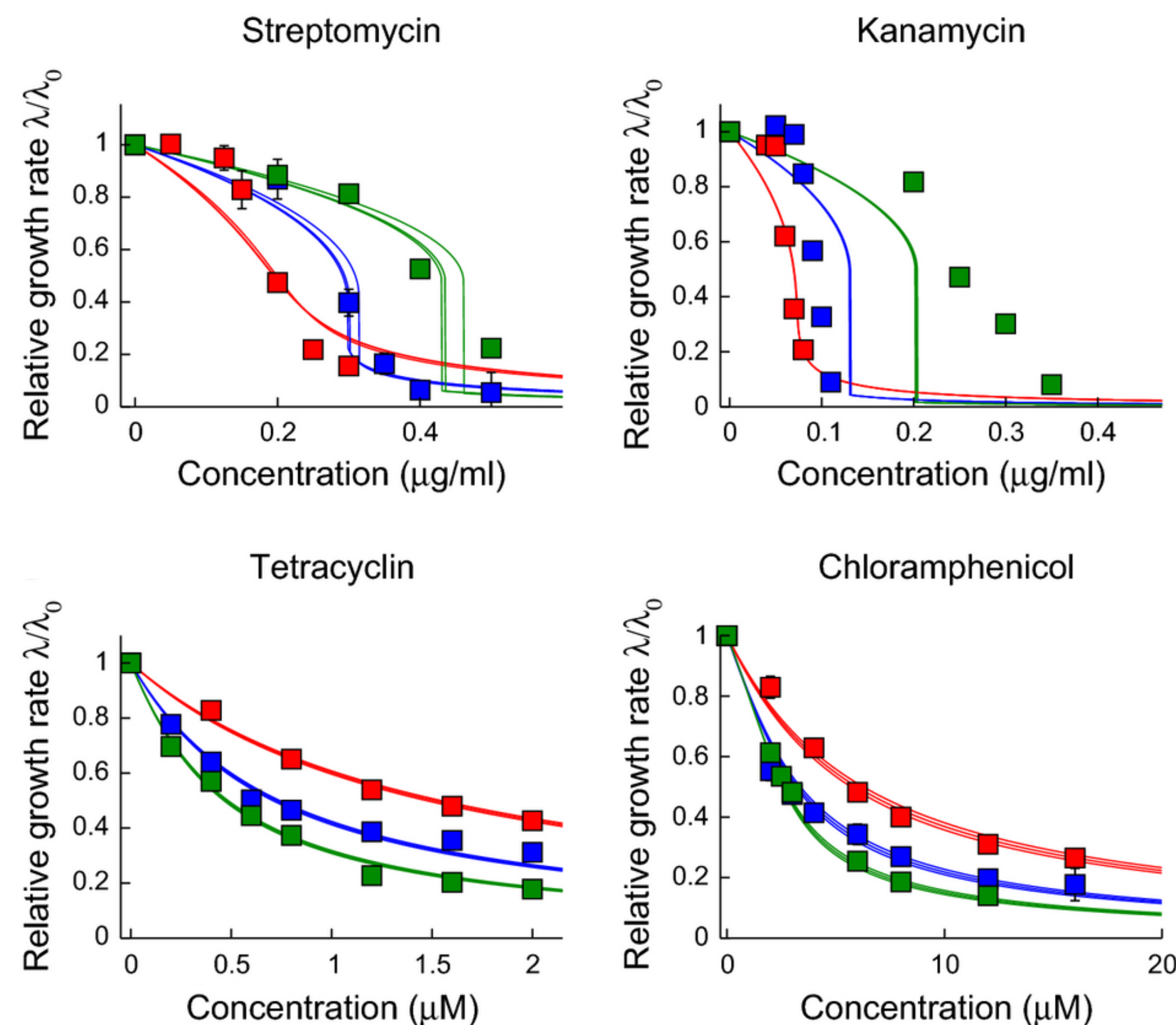
Fit two parameters
for <u>all the curves</u> in each panel

Greulich et. al (2015)

	Gly	Glu	Gly_CAA	Glu_CAA	Gly_RDM	Glu_RDM
λ_0 (/h)	0.40	0.64	0.85	1.09	1.35	1.68

Model predicts the effect of antibiotics on growth rate

Fit two parameters
for all the curves in each panel

Greulich et. al (2015)

IC50 collapse on a single curve
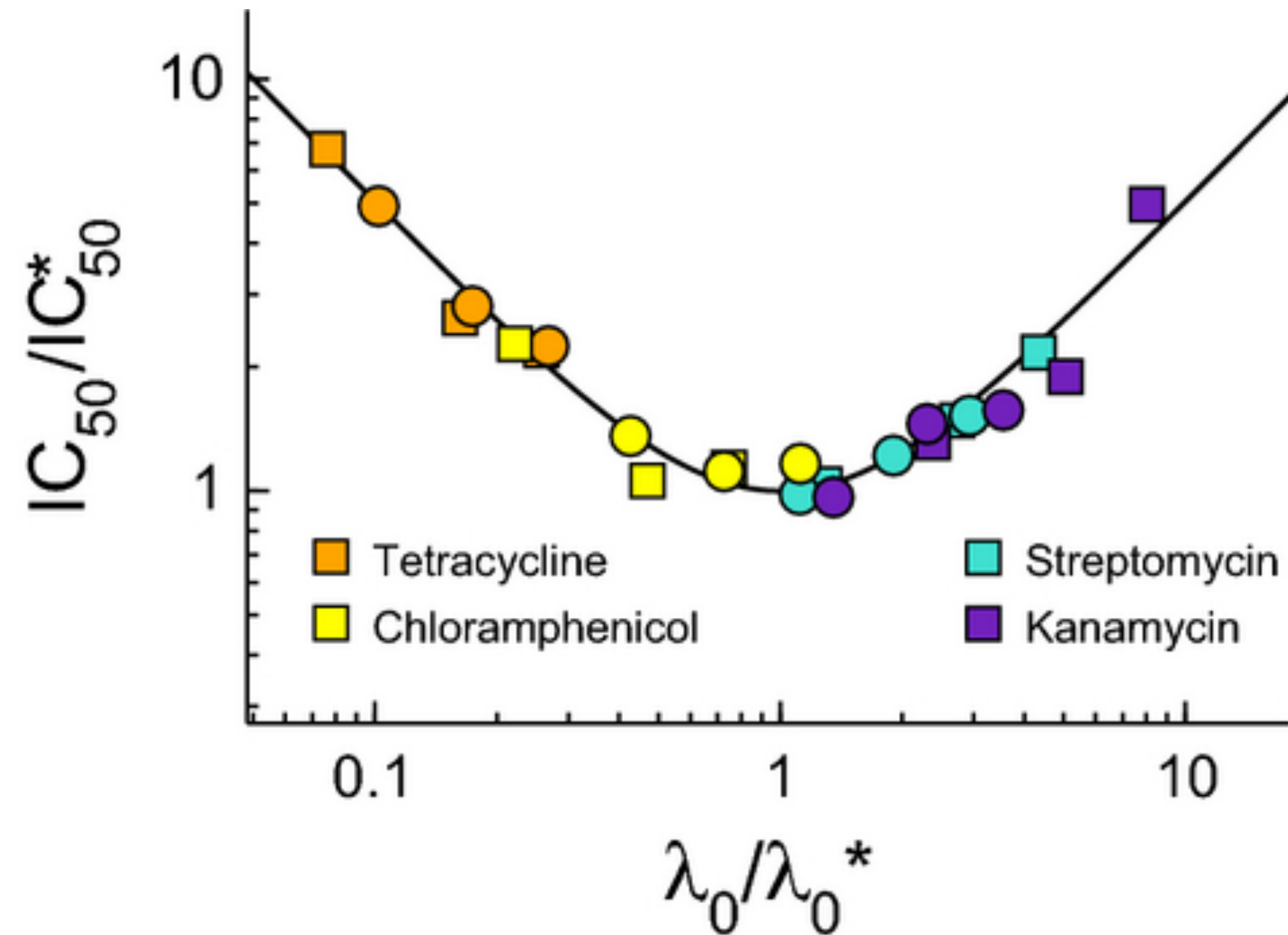
Greulich et. al (2015)

Testing model with a mutant with lower translational capacity

Greulich et. al (2015)

Testing model with a mutant with lower translational capacity
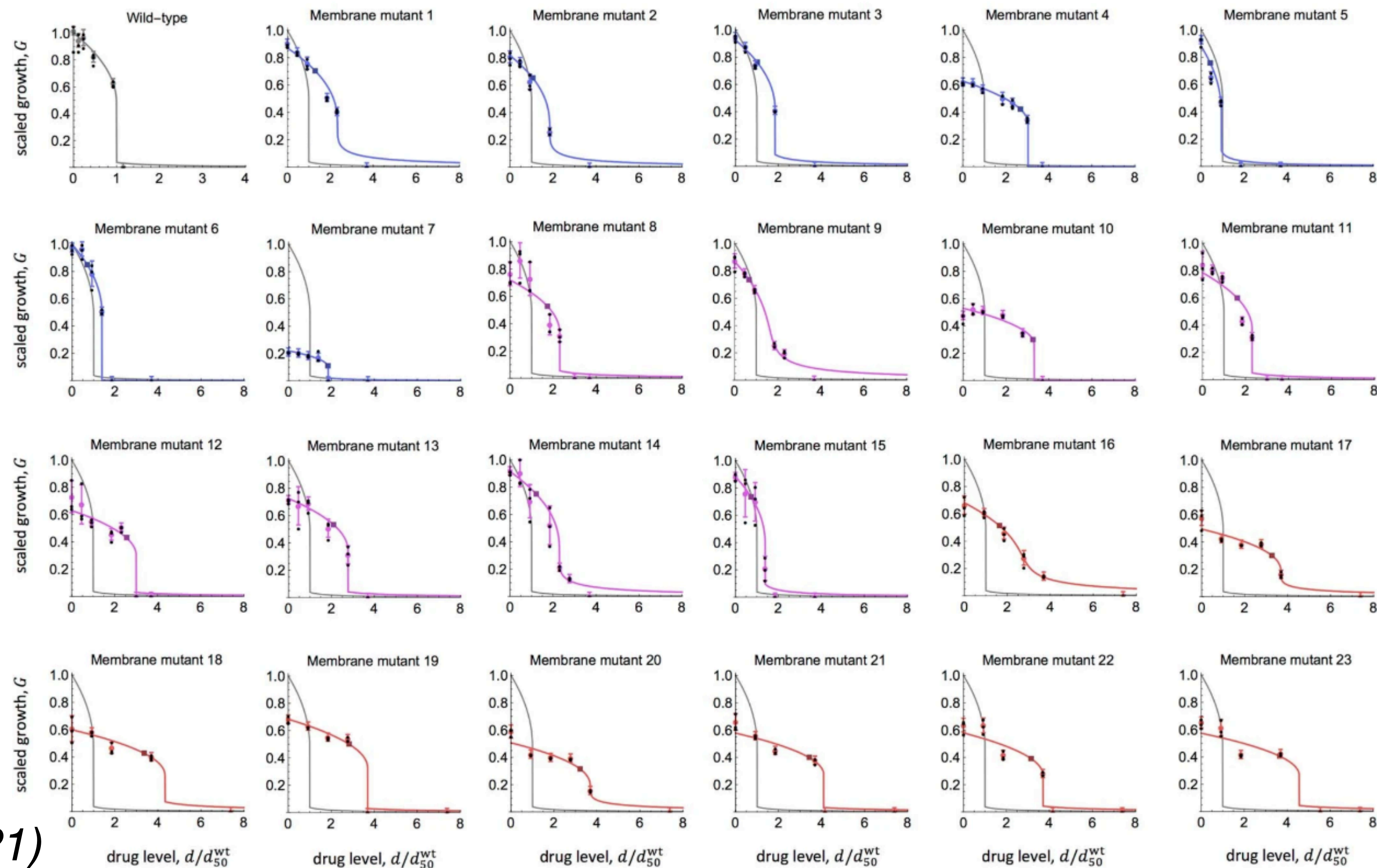

Greulich et. al (2015)
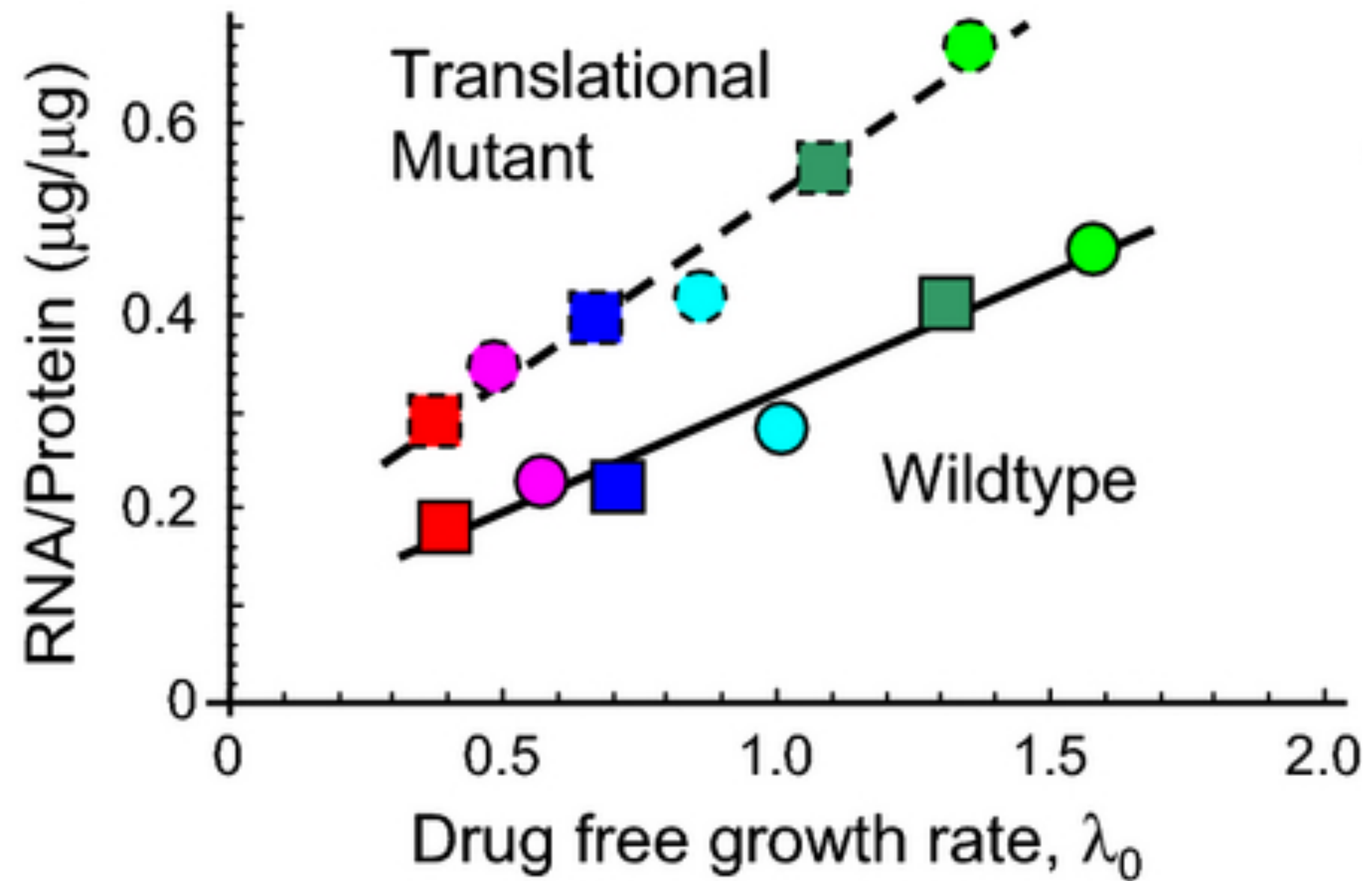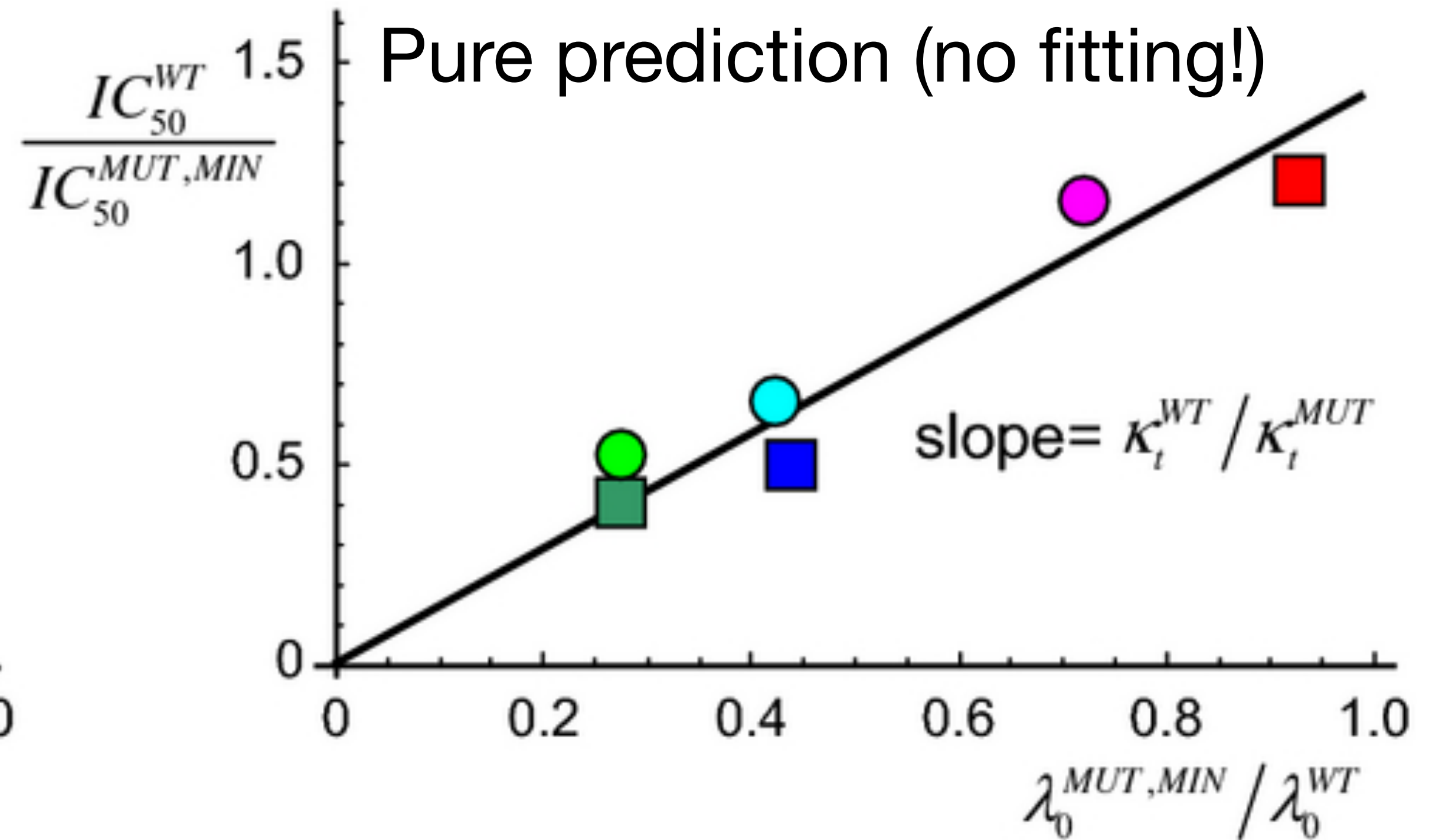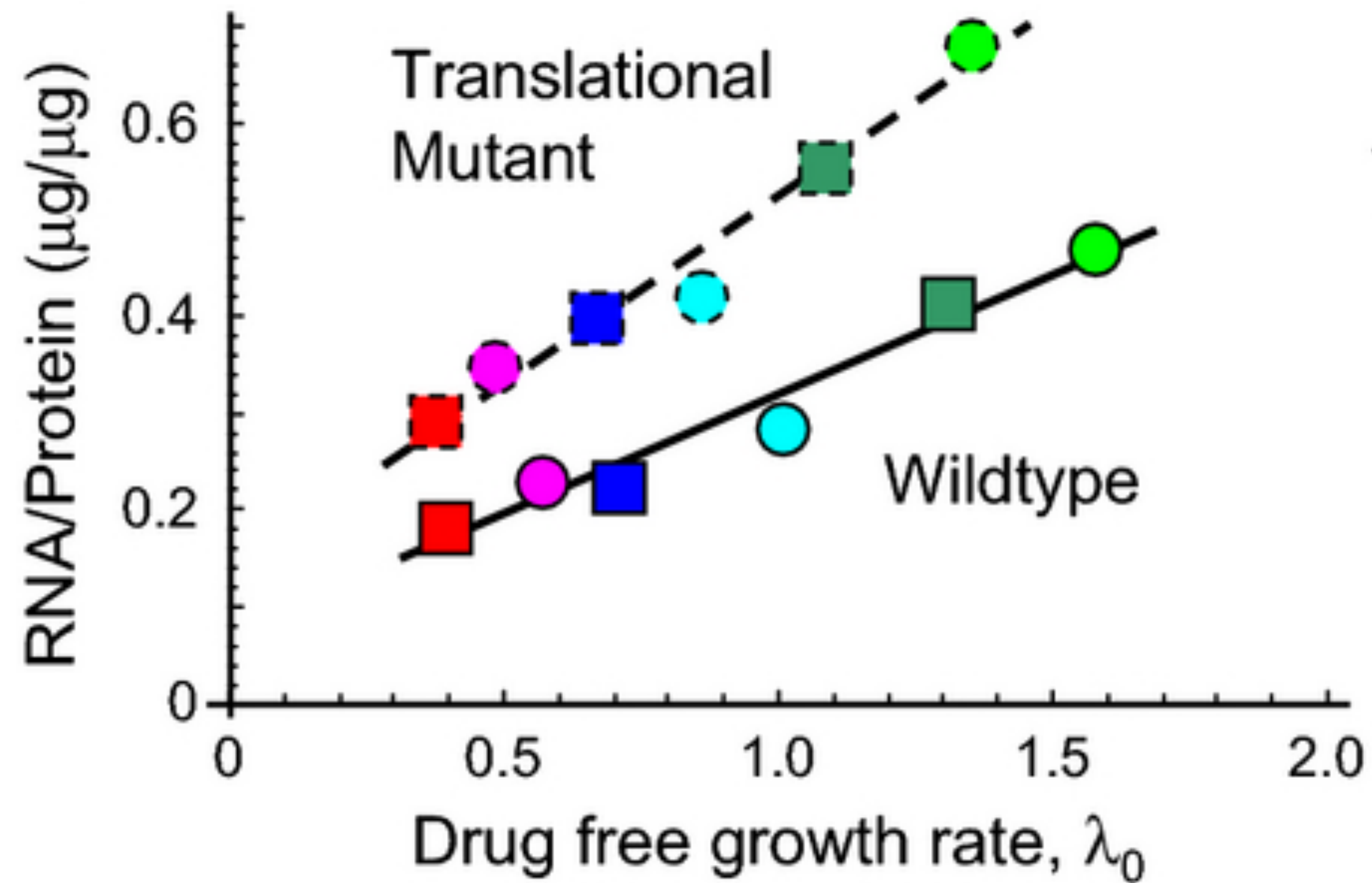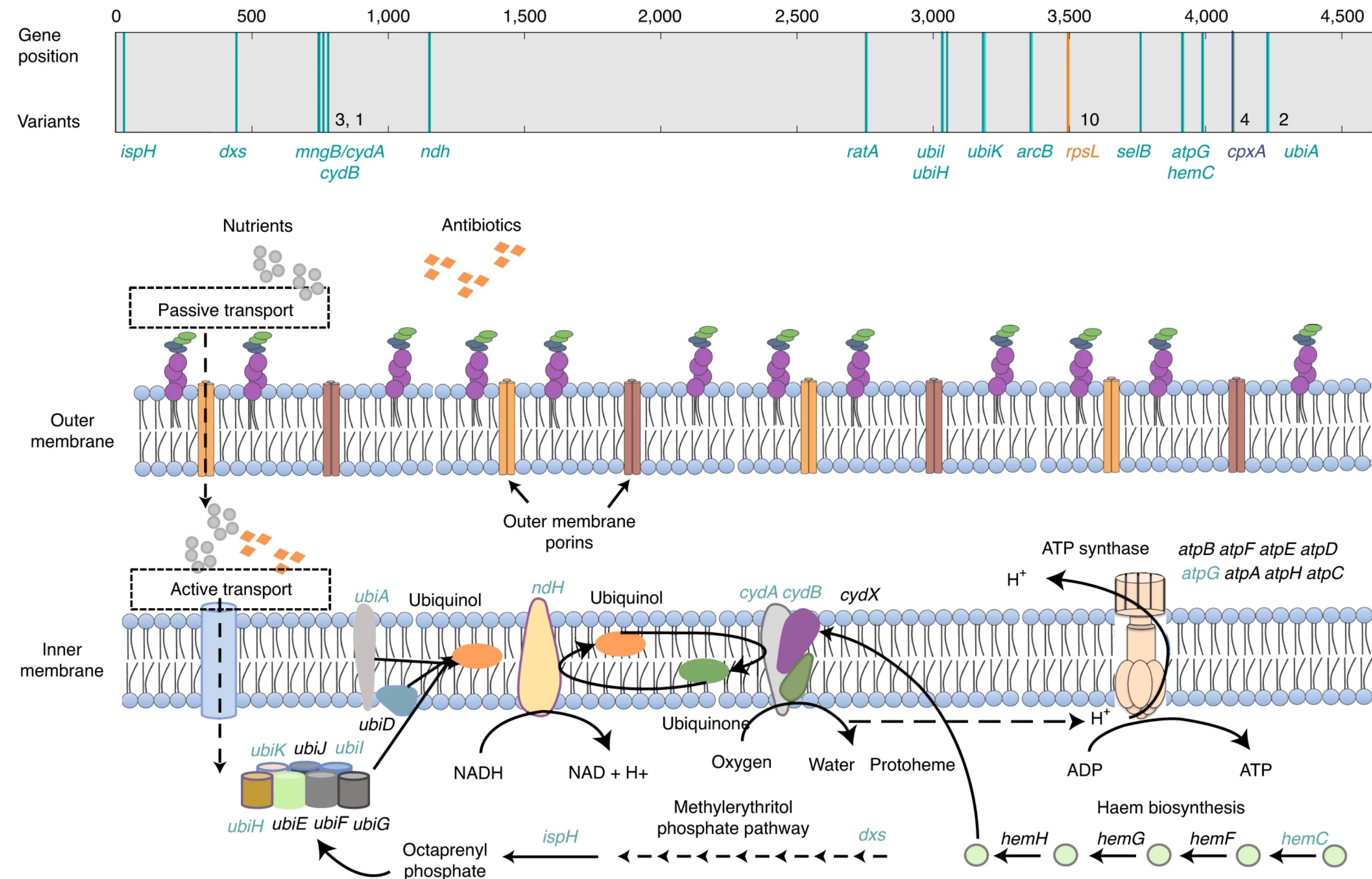
Resistance can evolve (also in the lab)

Mutant pay a cost to evolve resistance: they grow worse where drug is absent
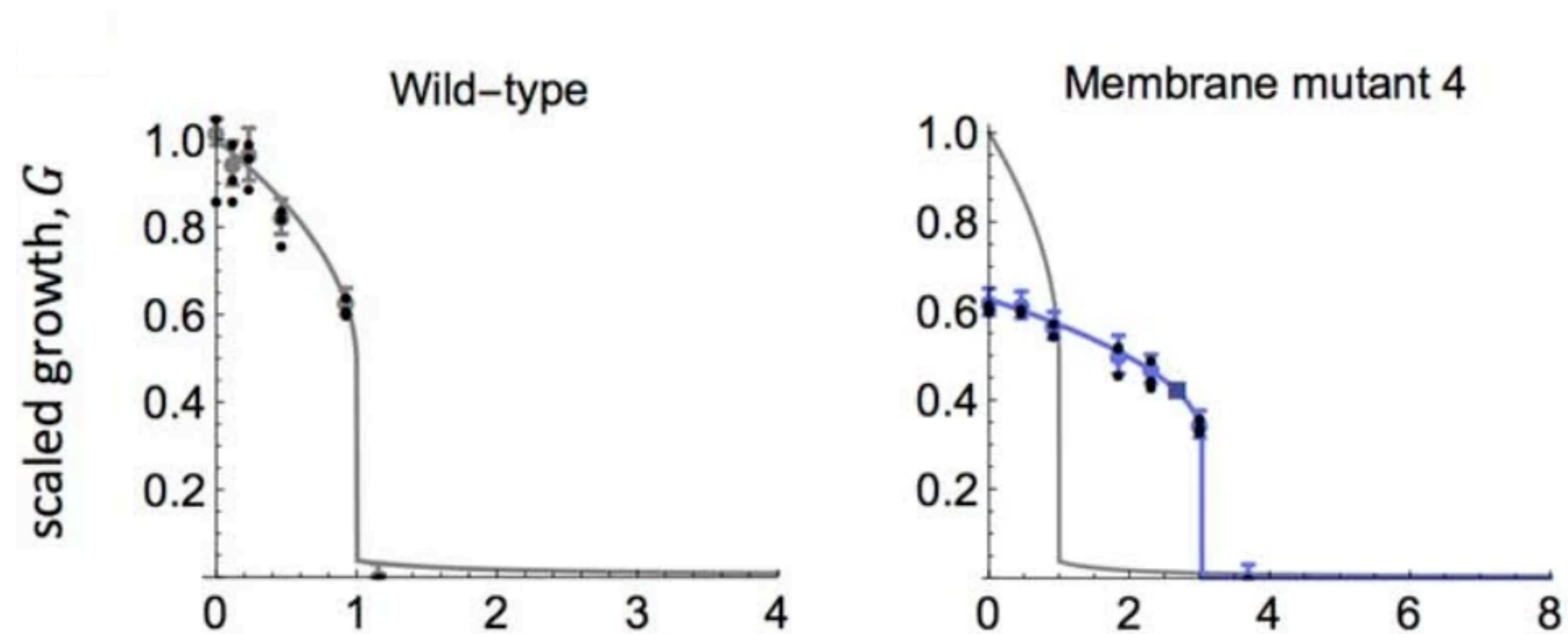
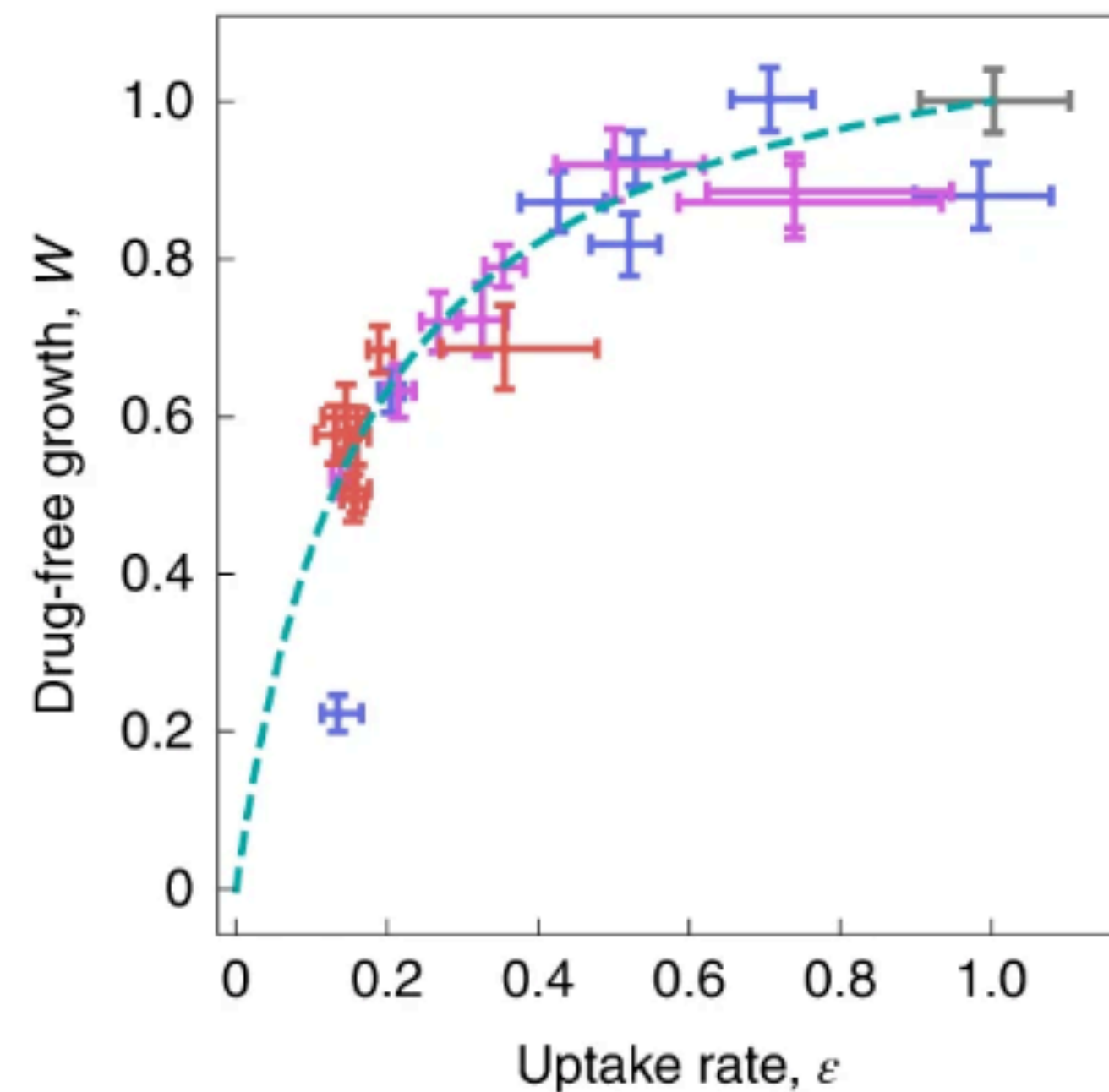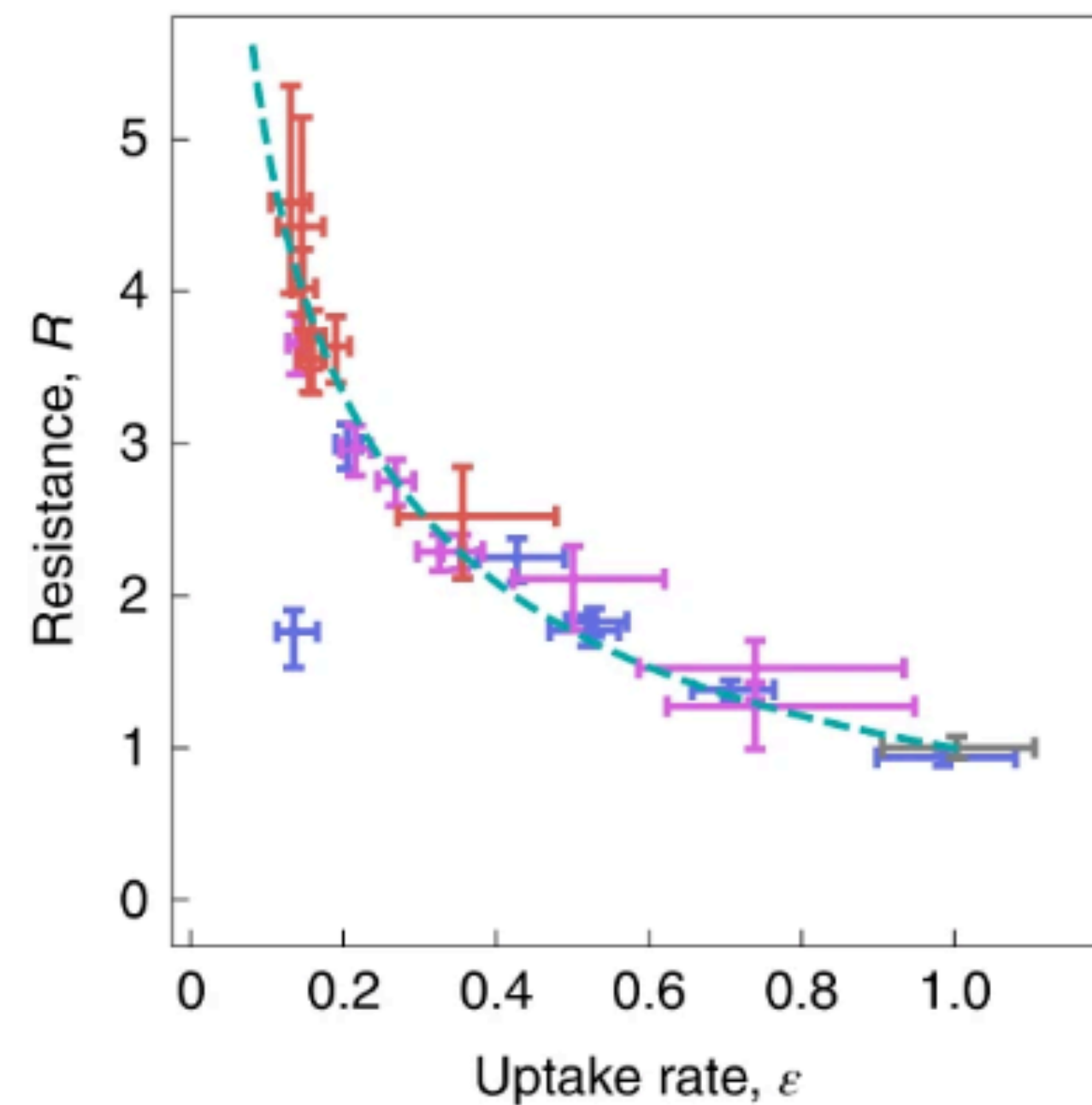# Mutant pay a cost to evolve resistance: they grow worse where drug is absent
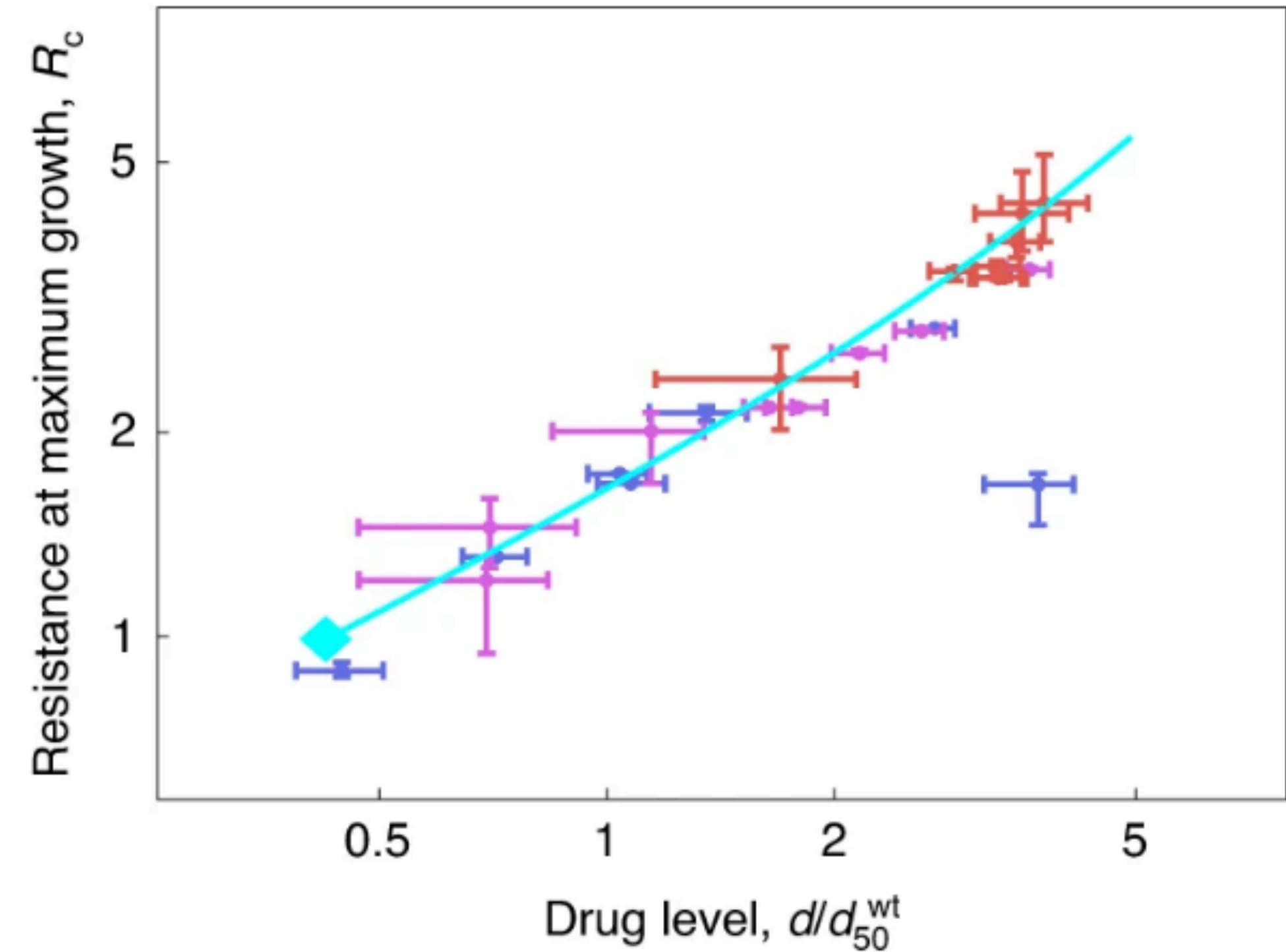

Pinheiro et. al (2021)

Mechanism(s) of resistance is complex, but is typically membrane/transport related

Pinheiro et. al (2021)

Tradeoff between cost and advantage is consistent with change of uptake rate of both antibiotics and nutrient

Pinheiro et. al (2021)
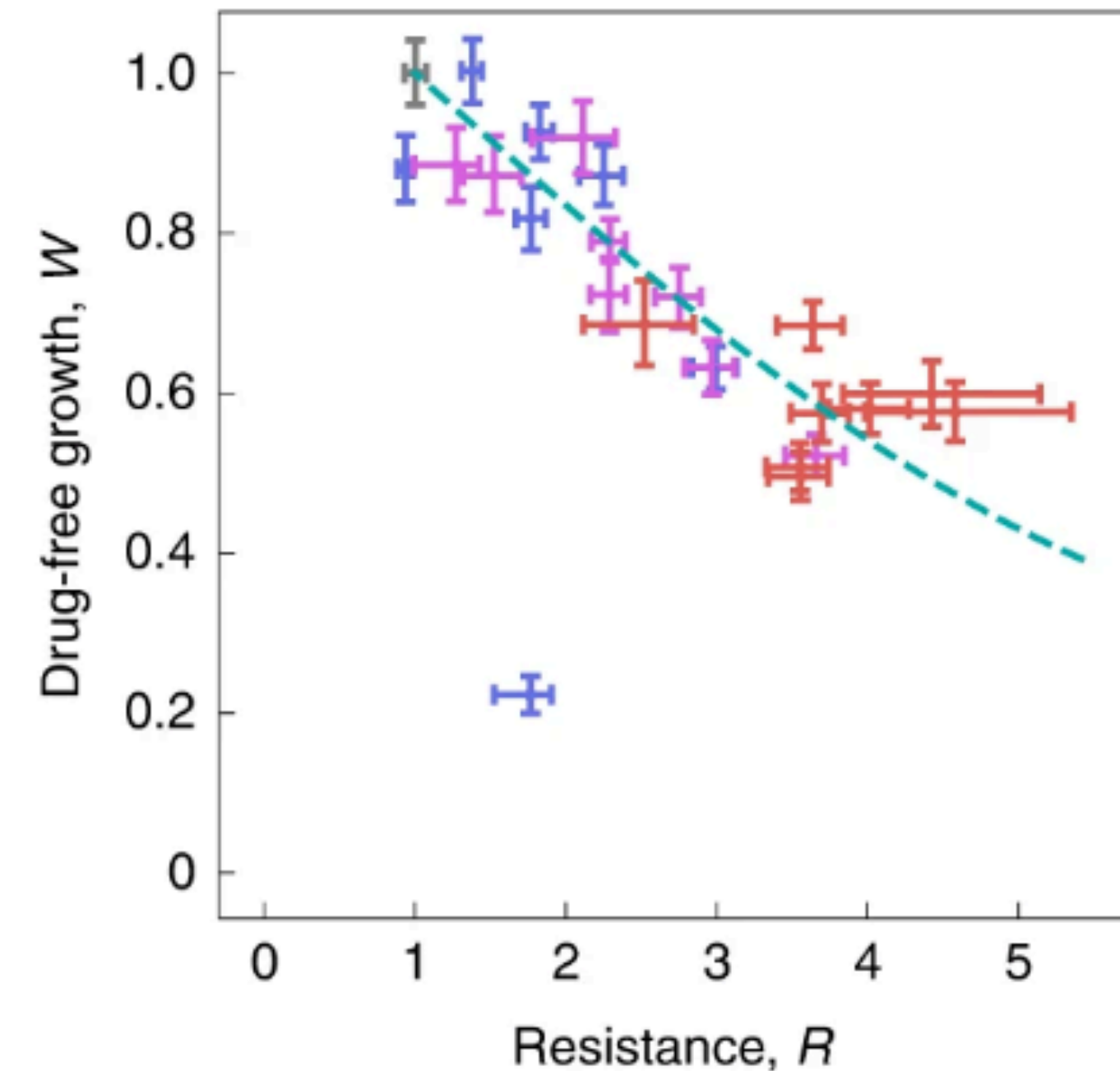
Optimal uptake rate depends on amount of drug during evolution

Pinheiro et. al (2021)
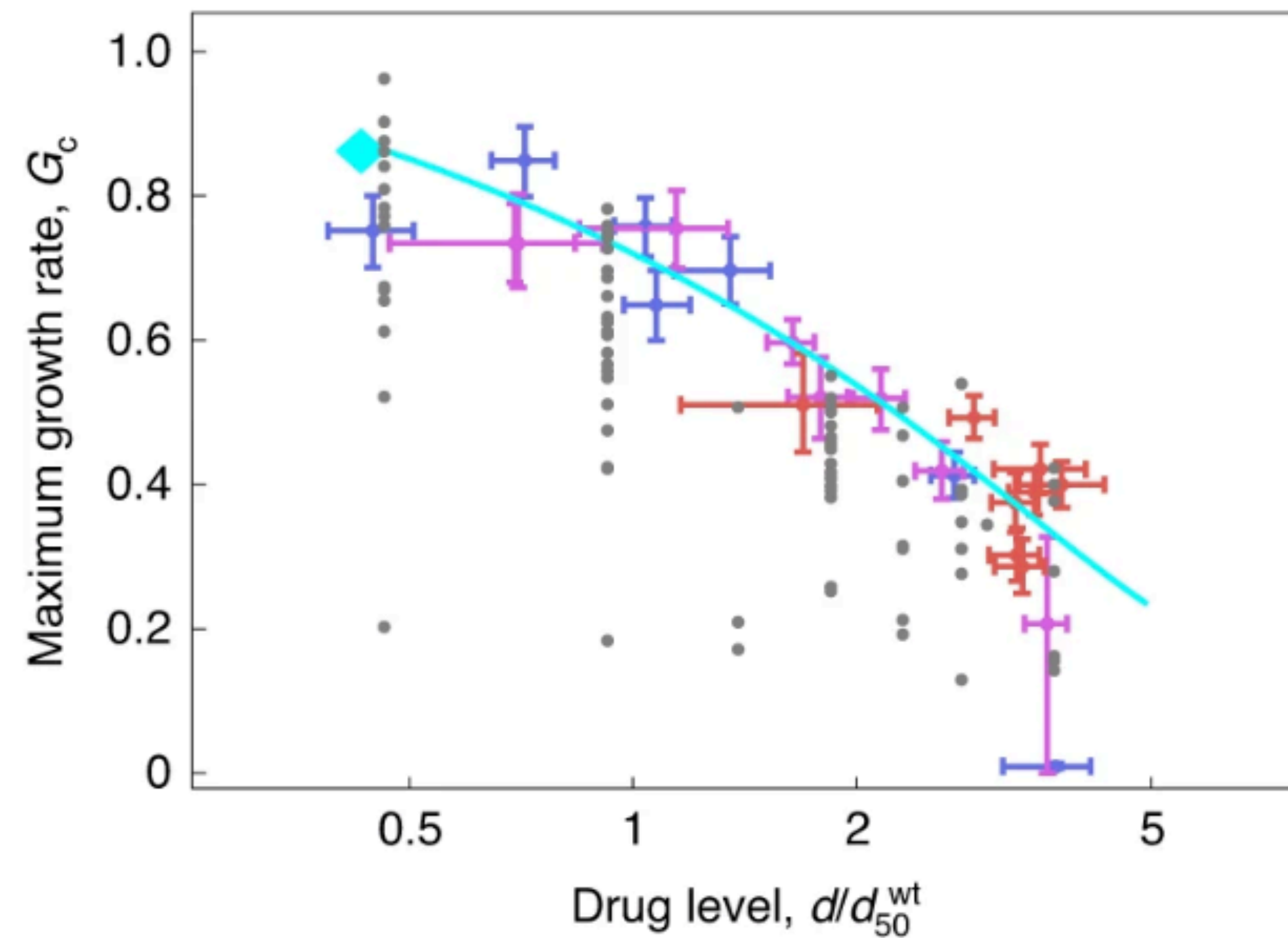
what else?

Predict lag time when changing conditions

Including explicitly transcription

Overflow metabolism

Effect of temperature on growth

Growth on multiple resources

Applications to ecology

…

what I want~~ed~~ to convince you of

Microbes (biological systems) do interesting and extremely complex things

There exist quantitative biological laws

It is possible to build quantitative, predictive theory in biology