

May the best trait win.

Attractiveness of Learned behaviors and prestige bias.

Elliot G. Aguilar^{1,2}
eaguilar@gc.cuny.edu

Alberto Acerbi^{2,3}
alberto.acerbi@gmail.com

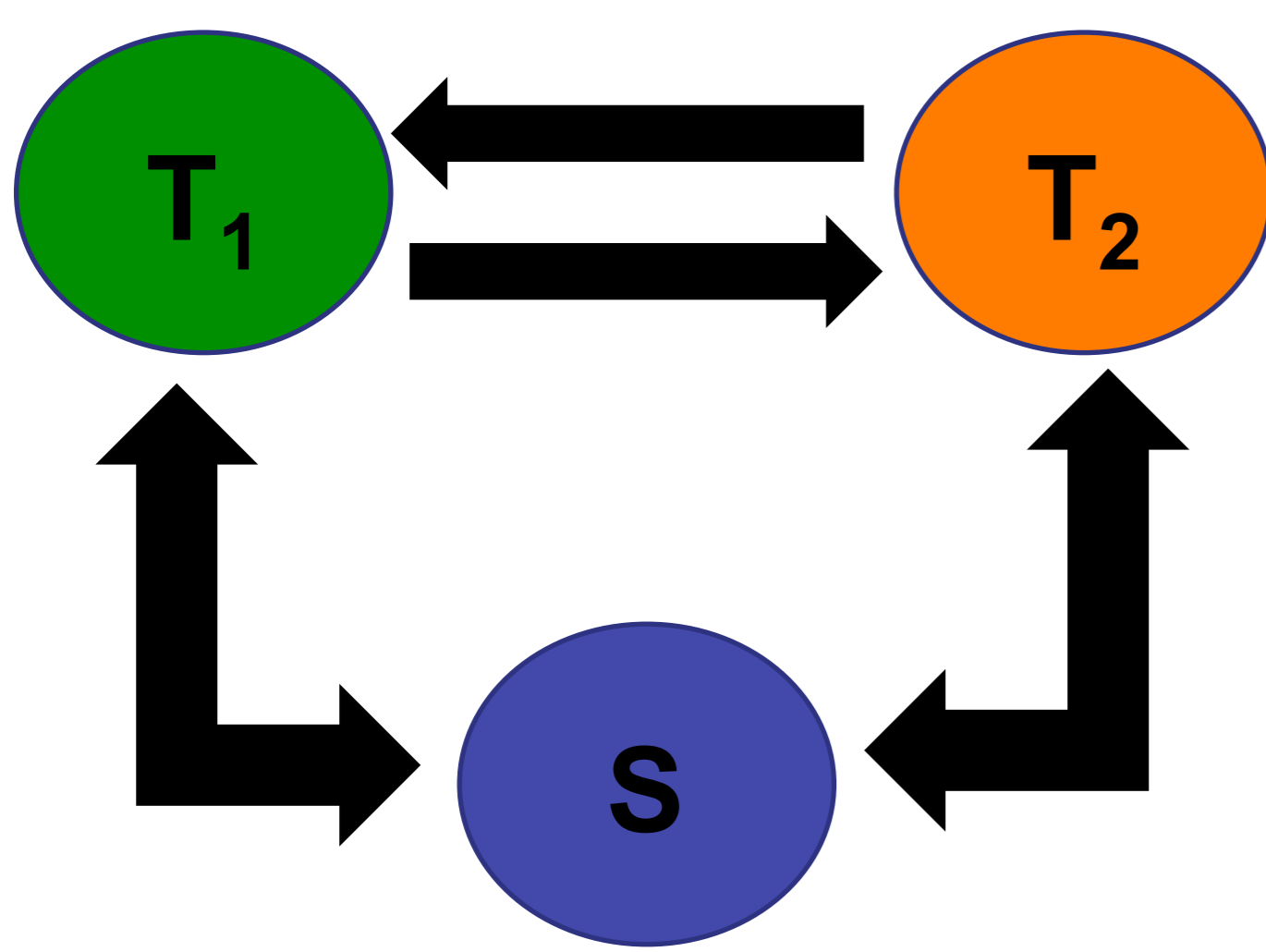
¹Dept. of Biology, Graduate Center, City University of New York
²Center for the Study of Cultural Evolution, Stockholm University
³Dept. of Anthropology, University of Bristol

Introduction

Cultural copying is subject to numerous forms of bias absent in genetic transmission. Numerous mathematical models explore the effects of model-based bias (e.g. conformity/anticonformity, prestige, etc.). Other biases, such as so-called cultural attractors (Sperber 2012), have been proposed as powerful factors in learned trait transmission. Here, we present a model for cultural copying when individuals are biased towards what they copy, rather than from whom they copy. In our model, the only factors that affect transmission are the intrinsic features of a trait.

1. Attractiveness (a)
2. Retentiveness (r)

Model I



We use an SIS model with competing strains to model exclusive cultural traits. Individuals start in the 'susceptible' category, S, and acquire one of two traits via mass-action transmission. Individuals can also drop their present trait for the alternative, or abandon a trait according to its retentiveness.

$$\begin{aligned} \frac{dT_1}{dt} &= a_1 T_1 S + a_1 (1 - r_2) T_1 T_2 - (1 - r_1) T_1 - a_2 (1 - r_1) T_1 T_2 \\ \frac{dT_2}{dt} &= a_2 T_2 S + a_2 (1 - r_1) T_1 T_2 - (1 - r_2) T_2 - a_1 (1 - r_2) T_1 T_2 \\ \frac{dS}{dt} &= (1 - r_1) T_1 + (1 - r_2) T_2 - a_1 T_1 S - a_2 T_2 \end{aligned}$$

Results I

- There are no equilibria at which both traits coexist
- Invasion criterion is given by the standard result:
 $a_2 / (1 - r_2) > a_1 / (1 - r_1)$

Model II

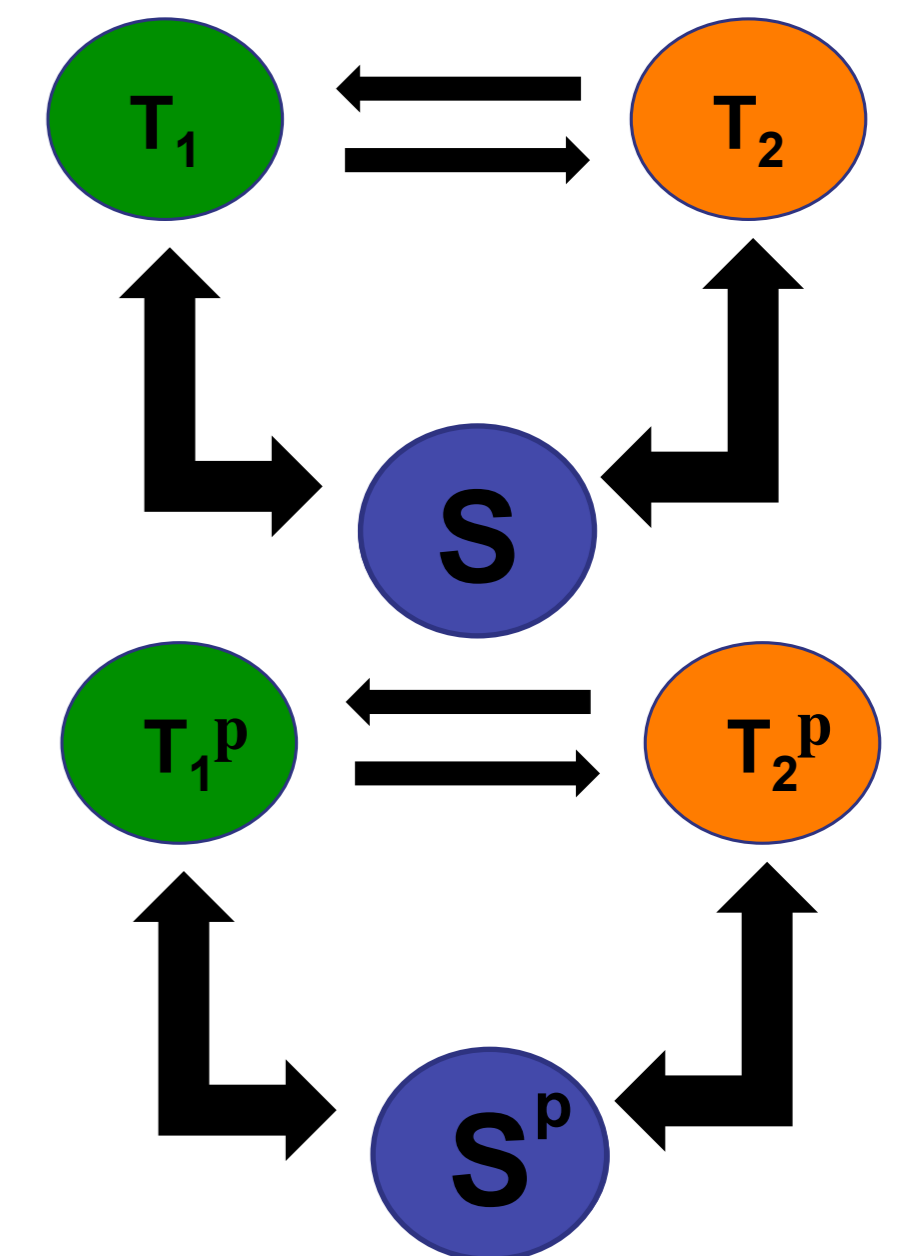
Here we consider a subdivided population with a 'prestigious' group who are preferentially copied by all other individuals according to a bias parameter p . If witnessed in a prestigious individual, a trait's attractiveness is modified as follows:

$$a_1^p = a_1 + p(1 - a_1)$$

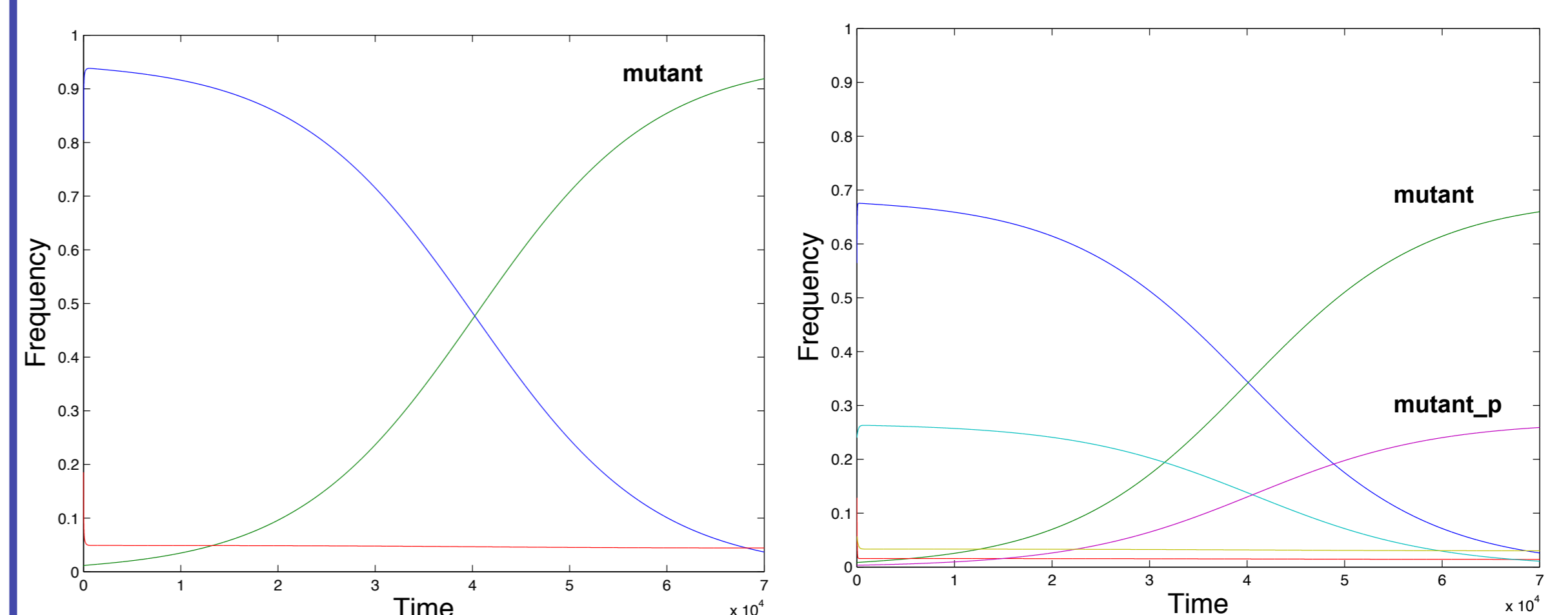
Prestigious individuals do not copy regular ones. We introduce additional mass action terms to represent interactions with prestigious individuals:

$$a_1^p T_1^p S + a_1^p (1 - r_2) T_1^p T_2 - a_2^p (1 - r_1) T_1 T_2^p$$

The equations for prestigious individuals mirror model I.



Results II



- The threshold condition for invasion is reduced.
- As long as the inequality from model I holds, the mutant will still invade.
- Prestige only slows the dynamics.

Conclusions

- As expected, when only content-based bias is present, the trait with highest growth rate excludes all others.
- Prestige bias cannot prevent the invasion of a trait that would invade under content-based bias.
- Individuals' assessment of a trait should be considered more strongly in its effect on cultural transmission.
- Further work should explore the combined effect of different forms of copying bias to get a more realistic picture of trait transmission.