Correlated evolution of discrete characters: Pagel's (1994) method

Alejandro Gonzalez-Voyer, Luke J. Harmon, & Liam J. Revell

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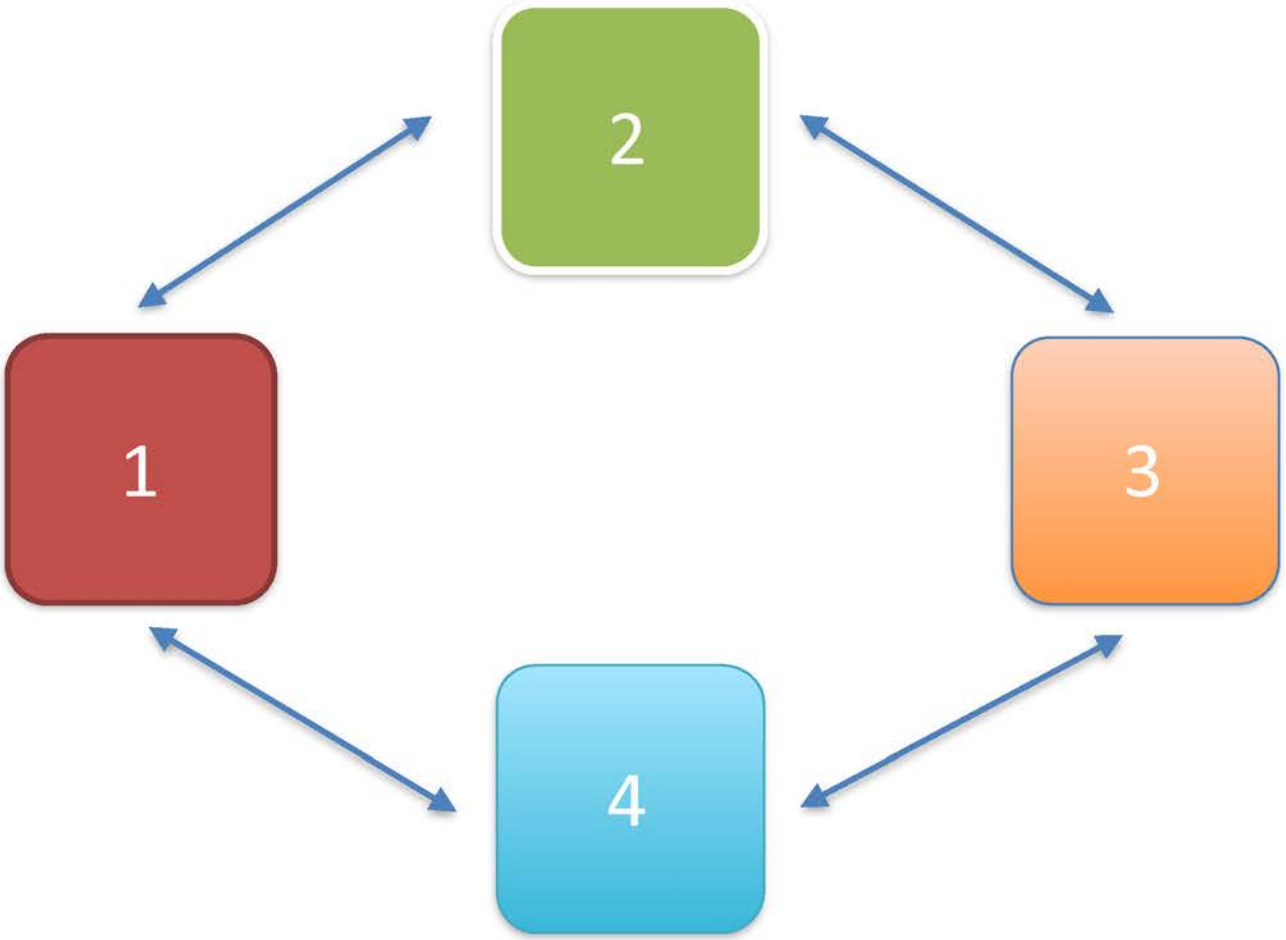
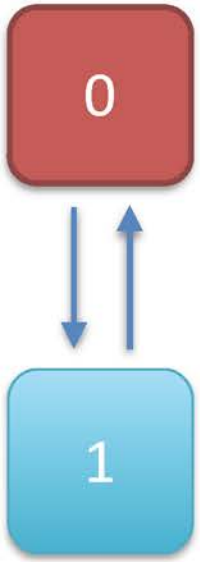
Discrete trait evolution



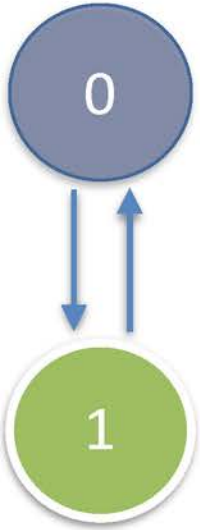
Do discrete traits evolve in a correlated fashion?

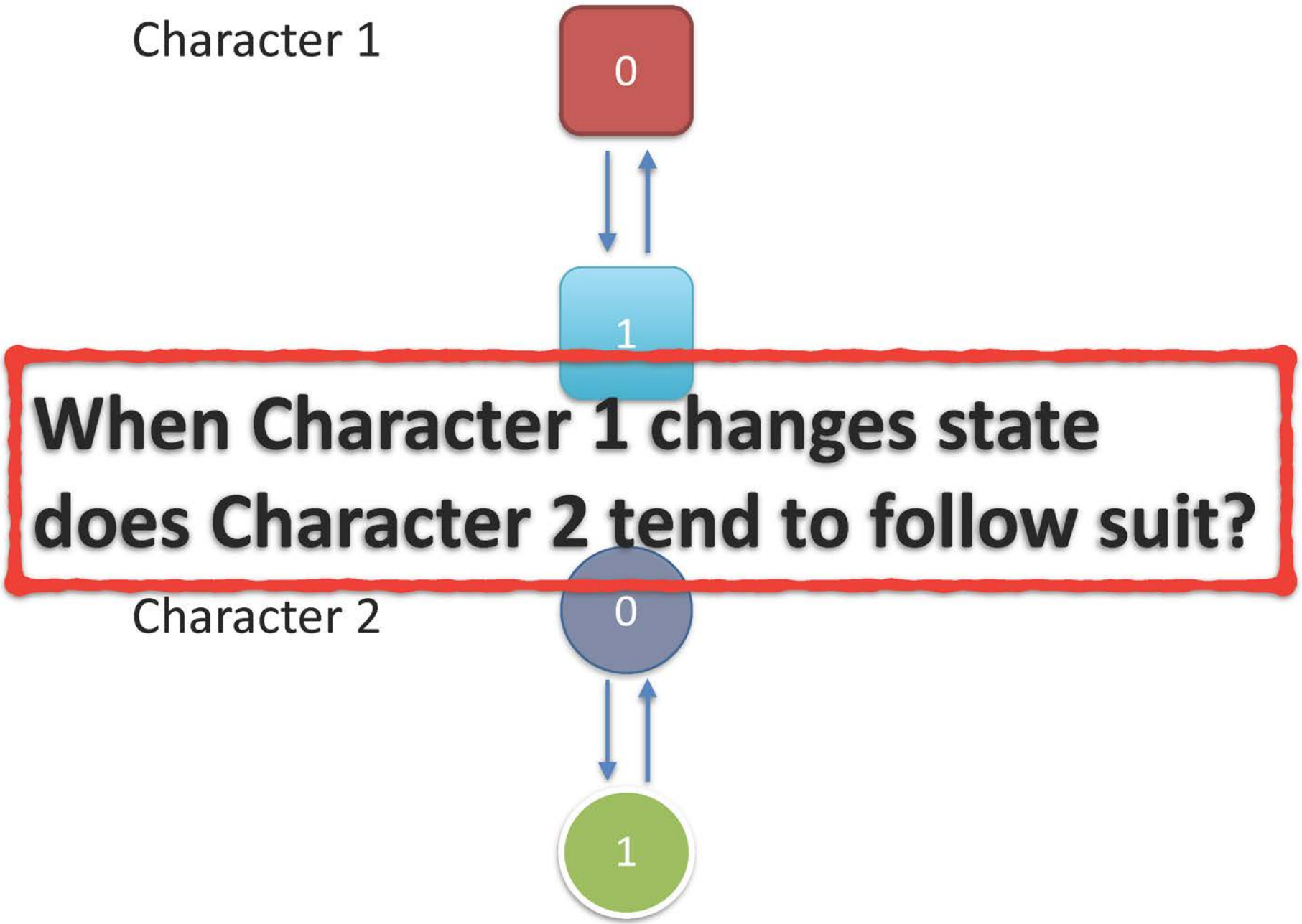
- Markov model:
  - Instantaneous rate of change
  - Estimate transition rates between traits
  - Compare 2 models:
    1. Independent model
    2. Dependent model

Character 1

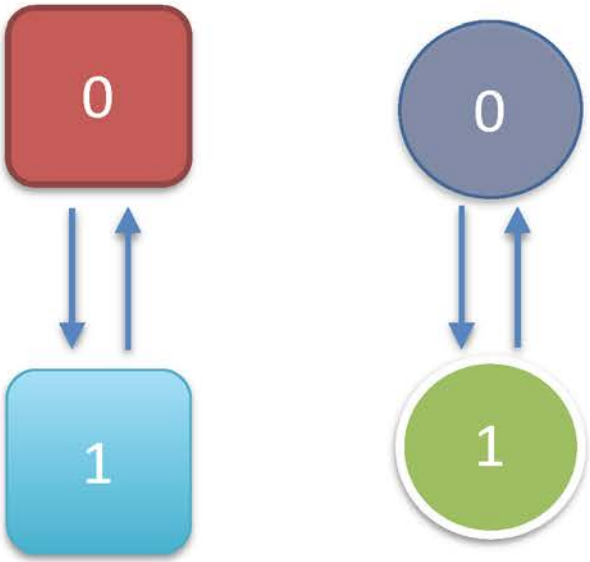


Character 2

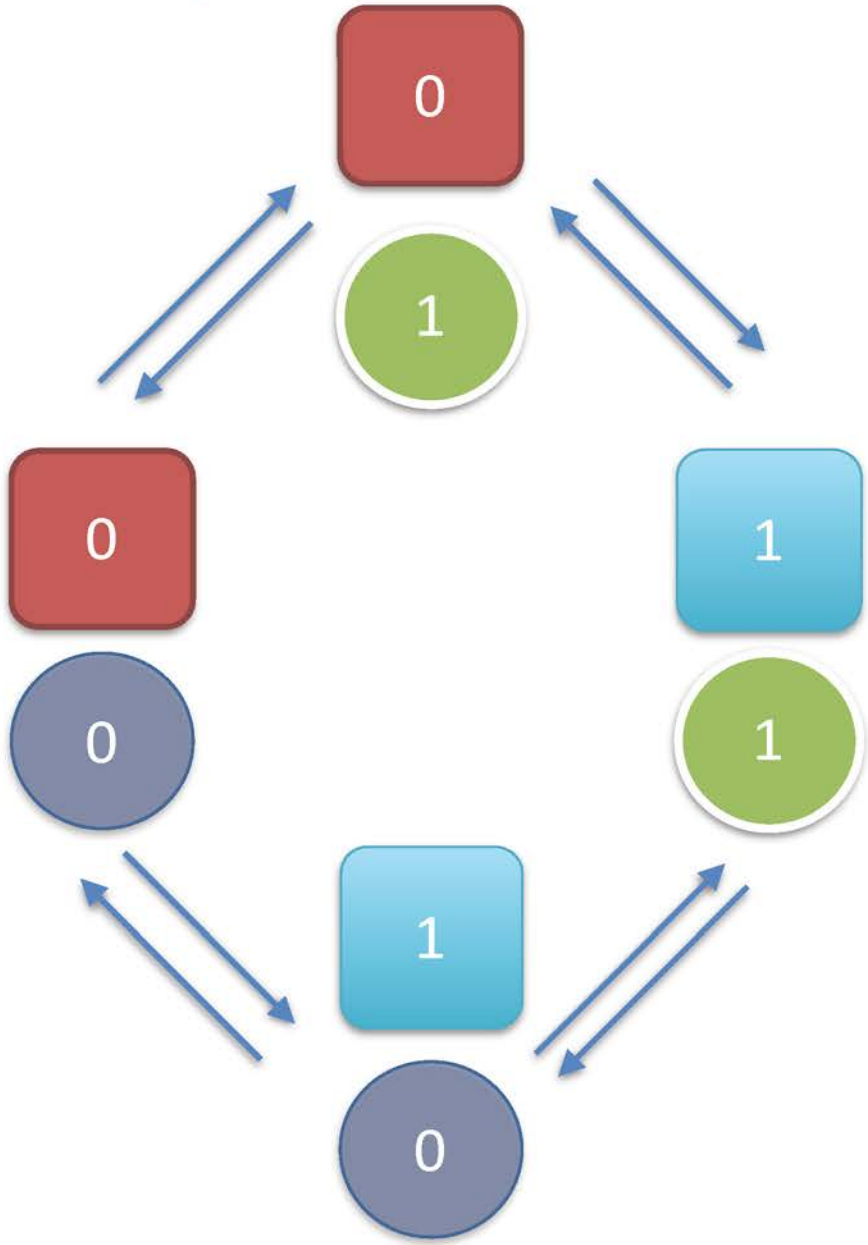



Character 1
0
1
When Character 1 changes state does Character 2 tend to follow suit?
Character 2
0
1

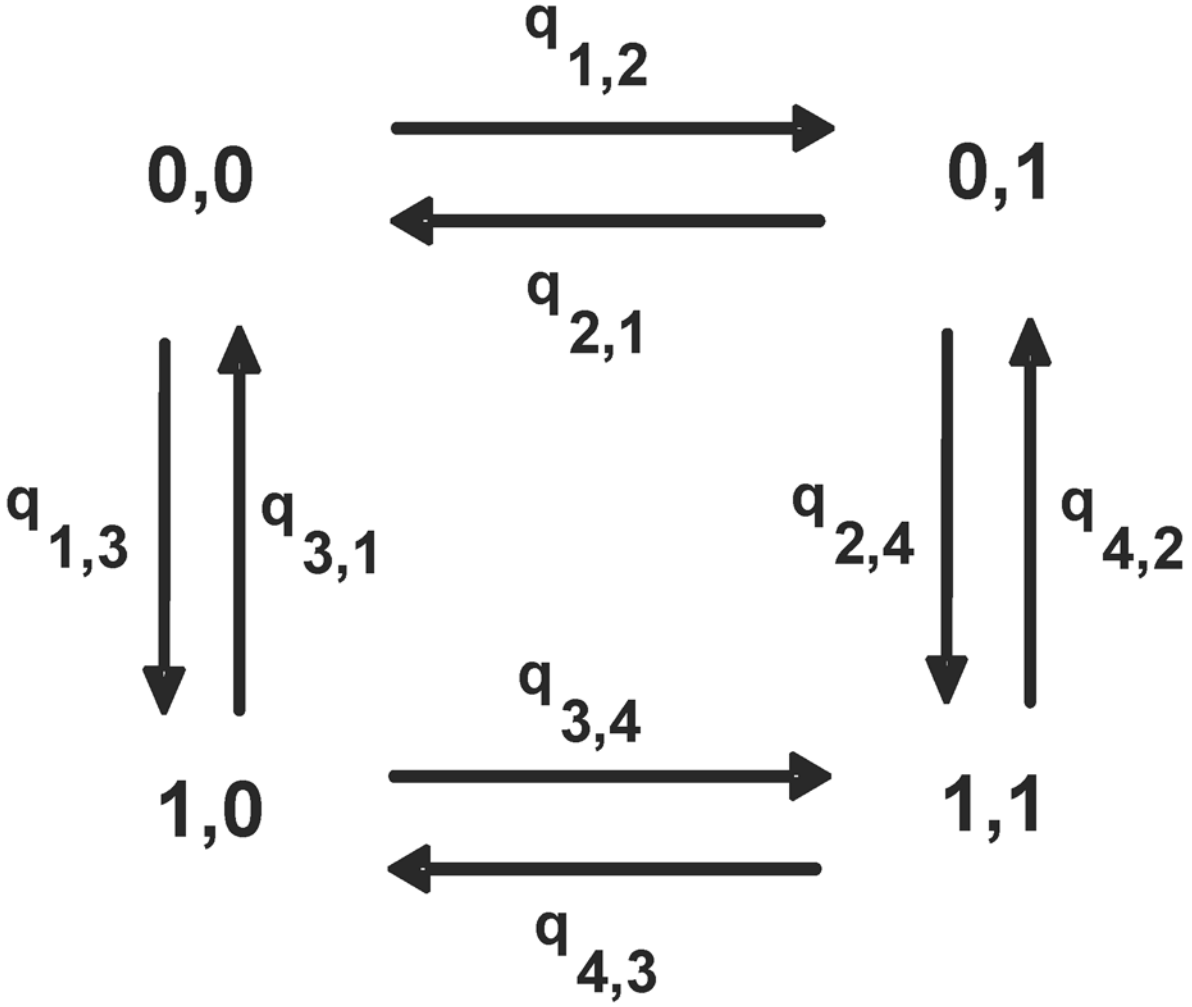
Independent model



Dependent model



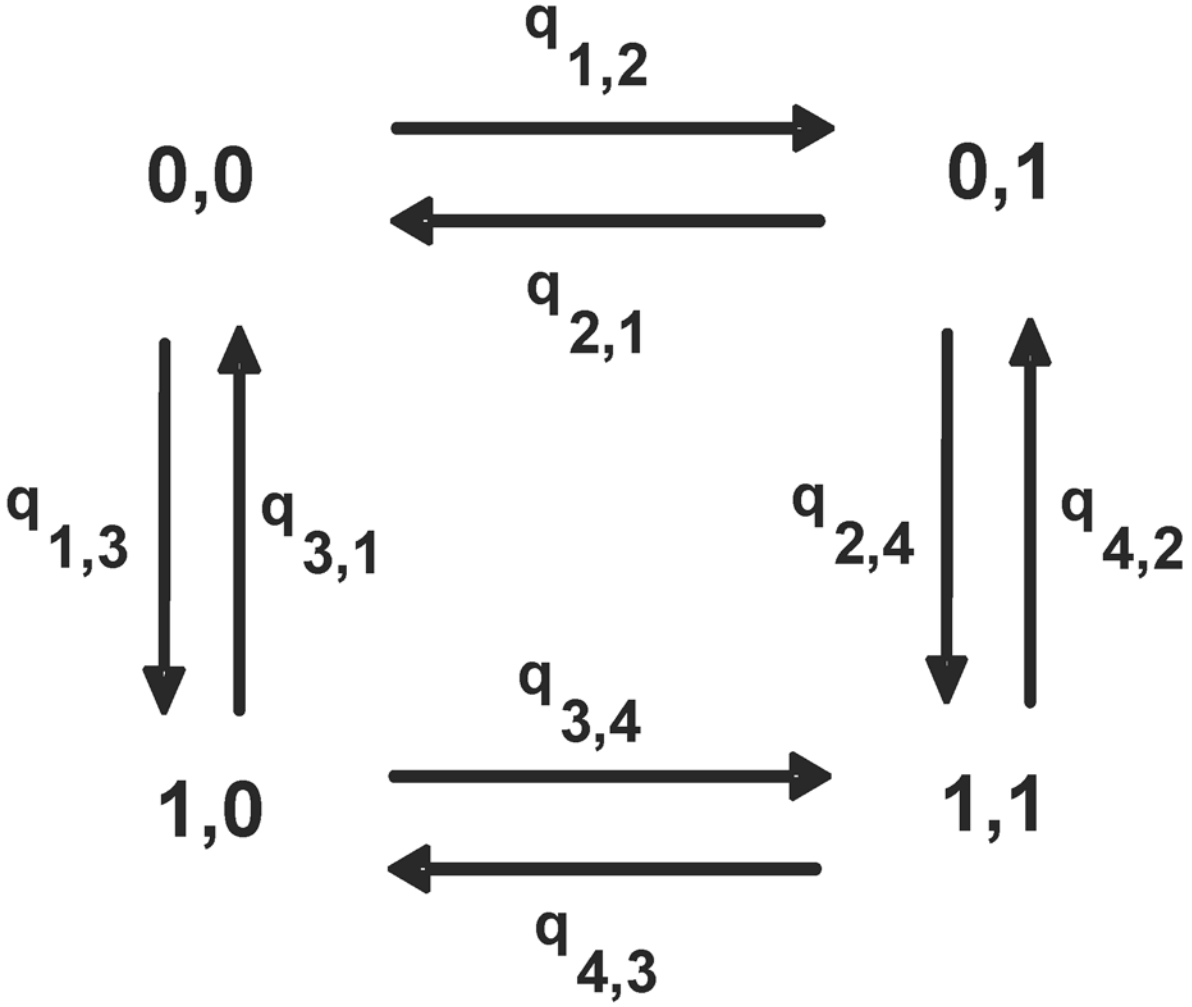
Model of correlated evolution

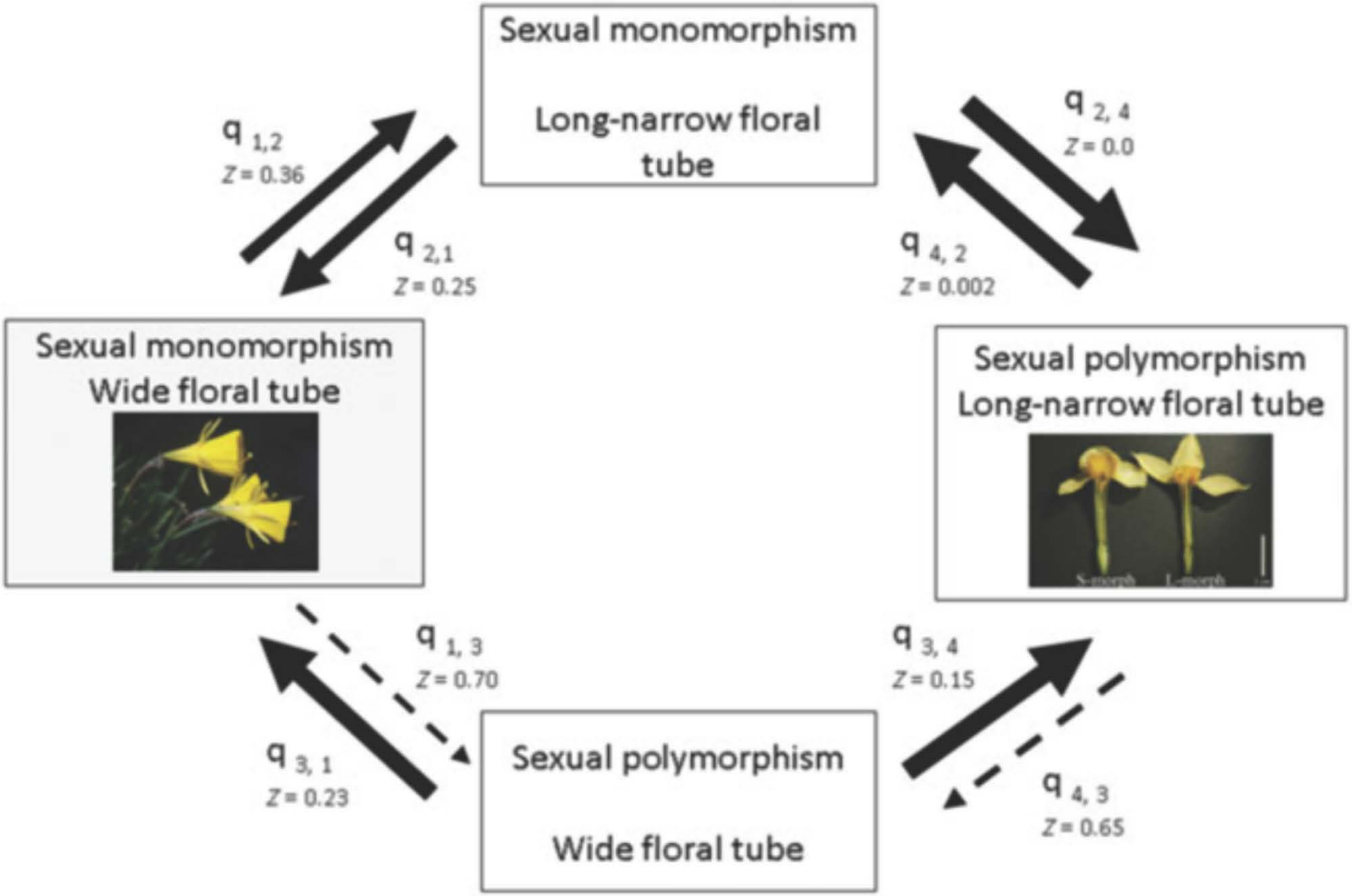


Correlated evolution of discrete traits

- Compare the fit of both models
- Maximum likelihood gives estimate of "goodness of fit"
- Can compare models with a Log-likelihoods ratio test

Model of correlated evolution





Santos-Gally et al 2013

Correlated evolution of discrete traits

- Mark Pagel's (1994) model can be used to test the hypothesis that binary characters are evolving in a correlated fashion.
- However, the comparison of this model to a null model of no correlation also involves the assumption that the evolutionary process is homogeneous (constant) through time.
- In the challenge problem we will also explore the consequences of this assumption.