Statistical Analysis of Networks

Coevolution of Networks and Behavior

Learning Goals

- Understand the logic of the coevolution model.
- Reasons for using coevolution model.
- Understand **network** and **behavior** configurations.

Introduction

- Last week: How do networks change? (network dynamics)
- This week: a new question…
  - *How do networks* **and** *behavior coevolve?*

Interdependence

- As we have seen, tie formation (i.e. network dynamics) can depend on behavior.
- Examples:
  - Homophily (Ego has a preference for being tied to alters with similar/same attribute values)
  - Receiver & Sender Effects (Ego has a preference for sending ties to those with a particular attribute)

Interdependence

- However, *behavior* can depend on network properties.
  - Examples:
    - Assimilation/Contagion (adopting attitudes of those around you)
    - Isolation (those with no friends may become depressed)

Separating Mechanisms

- As a consequence, we are trying to separate the mechanisms that generate the networks we observe.
  - Example:
    - Delinquent individuals **select** delinquent friends.
    - *Or*, individuals engage in delinquency if their friends do.
      - In the cross-section, we cannot determine which mechanism is correct (could be either or both).

Say we observe these two cross-sections

t

$t + 1$

Say we observe these two cross-sections

t

t + 1

At time *t*, **ego** is a different "type" or attribute value than **alter** and is not connected to **alter**.

Say we observe these two cross-sections

t

t + 1

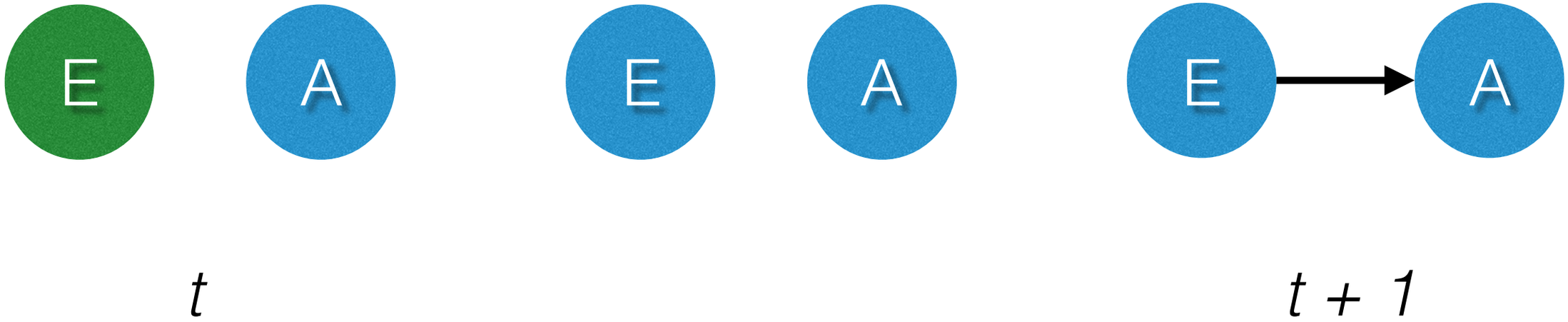
At time *t + 1*, **ego** is the same "type" or attribute value as **alter** and is connected to **alter**.

Say we observe these two cross-sections

t

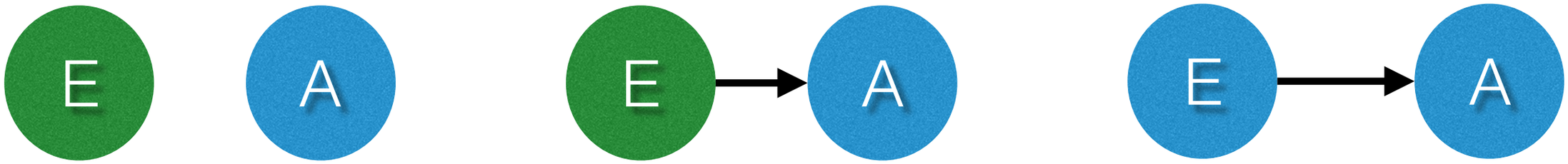
t + 1

Let’s think about the ways that this could have occurred (i.e. micro-steps).



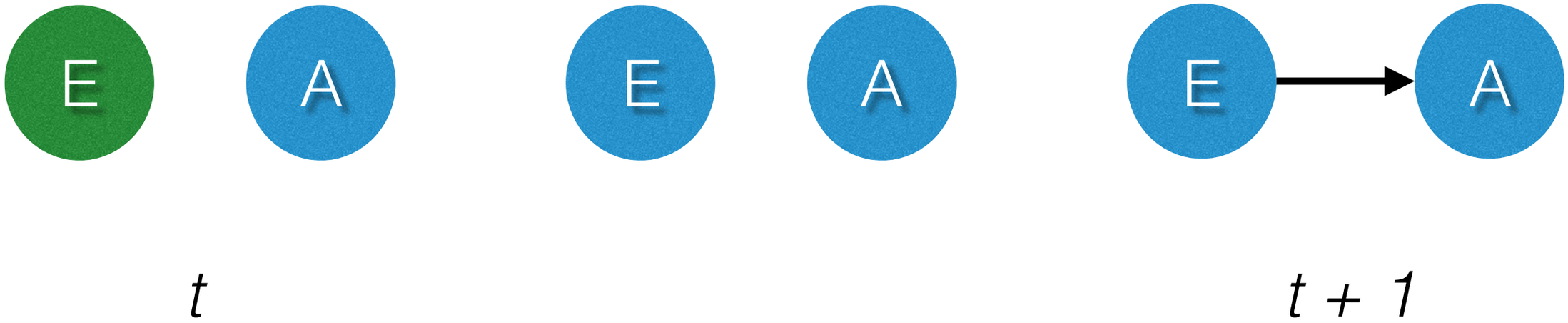
Ego changes his behavior, **then**
befriends alter.

Ego befriends alter, **then** changes his behavior.

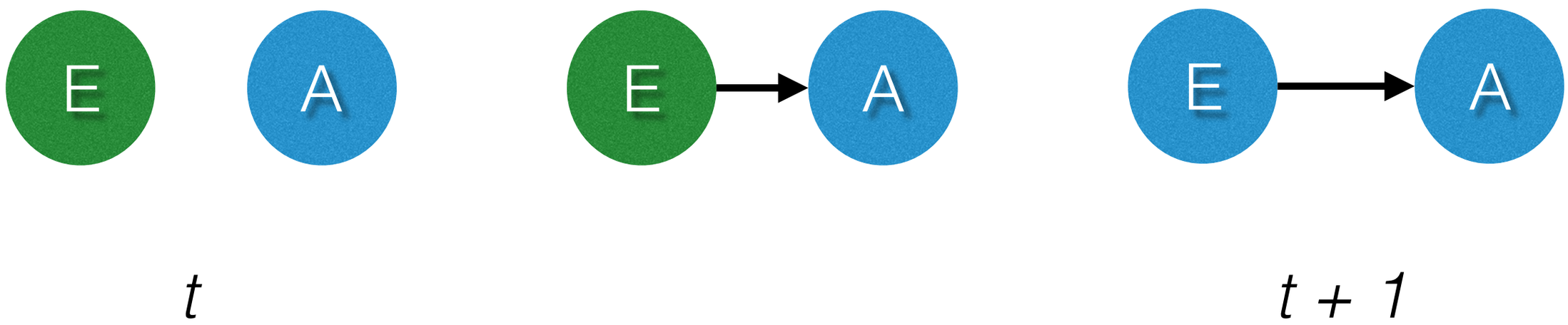


t

t + 1



We would like a model that shows the coevolution of both the network and behavior.



Separating Mechanisms

- The basic problem is trying to determine whether the observed network is a consequence of:
  - The network leading to behavioral alignment
  - Actors' behavior leading to network alignment
    - Coevolution models aim to construct a model that can tease these apart.

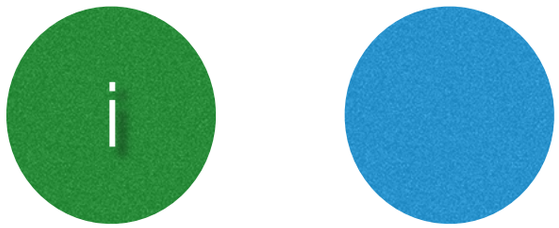
Stochastic Actor-Based Models

- We can extend the SABM logic to a behavioral domain.
- Now, actors control:
  - Their ties
  - Their behavior

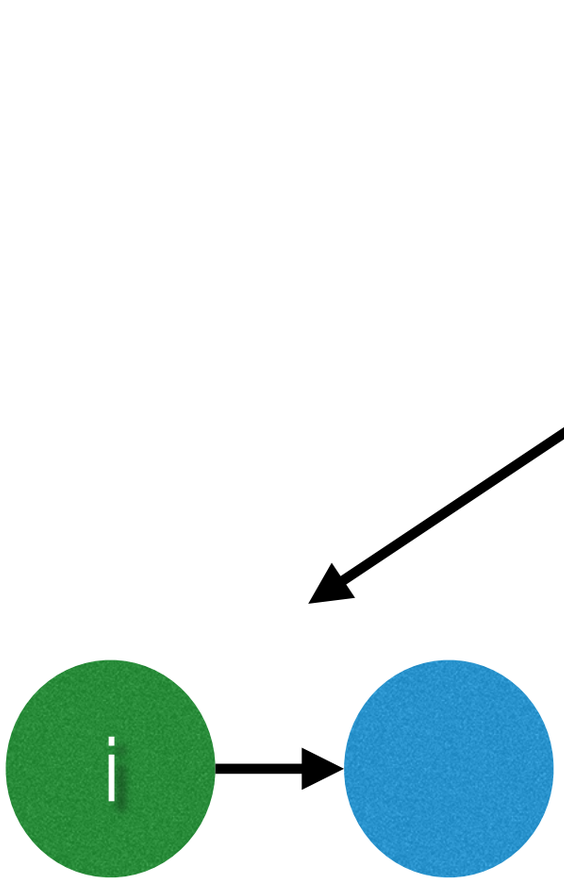
Stochastic Actor-Based Models

- We simply extend the functions to include behavior:
  - **Rate** functions for the network *and* for behavior.
    - How frequently are individuals changing ties? Their behavior?
  - **Objective** functions for the network and behavior.
    - What are actors' preferences for their ties? Their behavior?

What can *i* do?

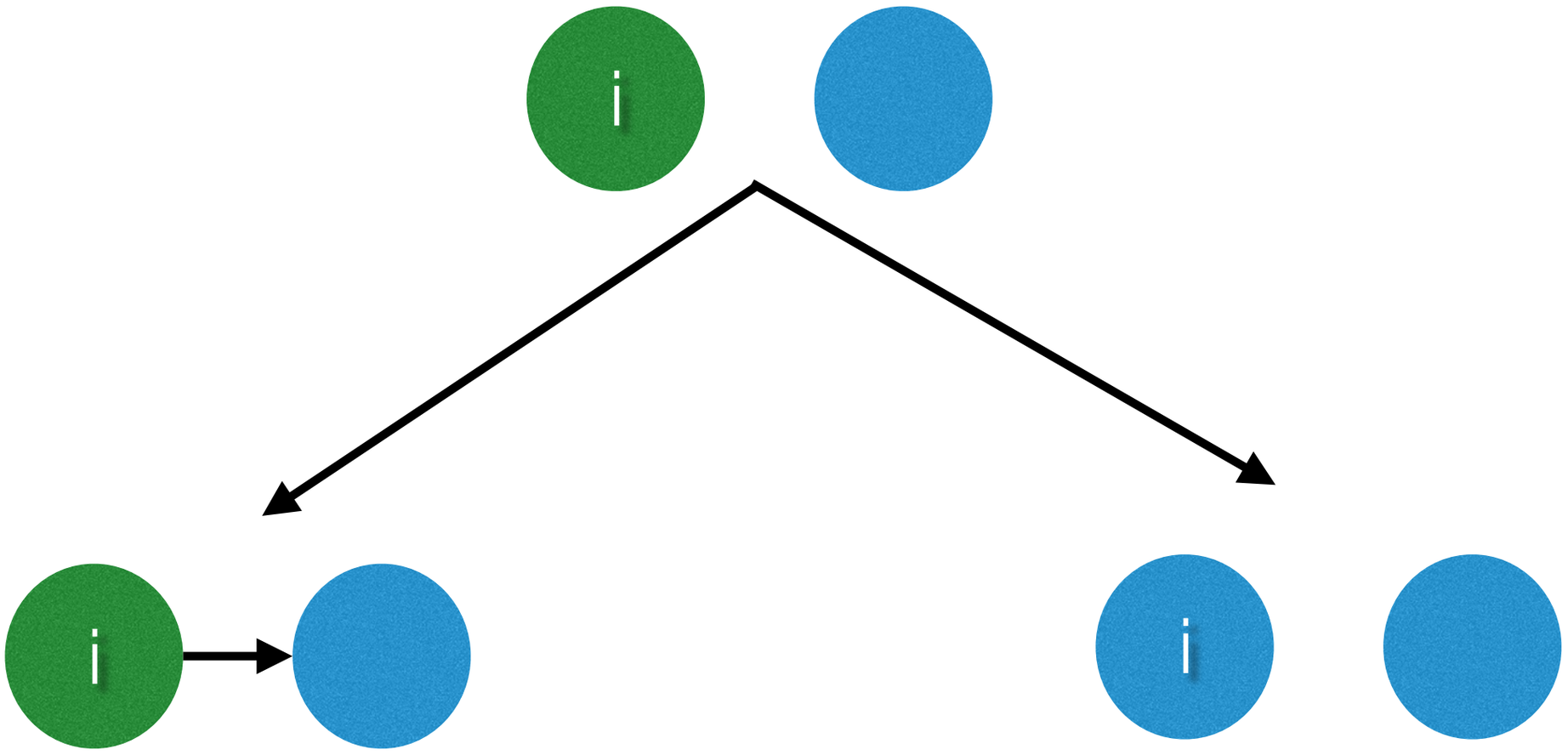


What can *i* do?



Change network
(*network objective function*)

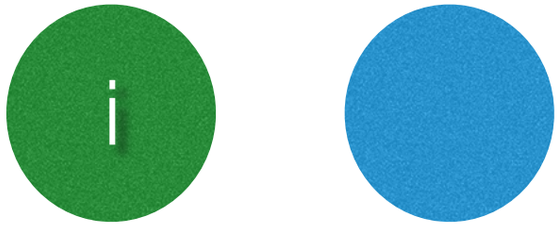
What can *i* do?



Change network
(*network objective function*)

Change behavior
(*behavior objective function*)

What can *i* do?



Not making any changes

(*behavior and network rate functions*)

is still an option as well

Objective Function

- As before, we want to specify the configurations.
- But, what is different is that in addition to **network** configurations, we are going to specify **behavioral** configurations.

Basic Effects

t	*t+1*	Effect (RSiena term)	Preference

Basic Effects

t	*t+1*	Effect (RSiena term)	Preference main behavioral tendency

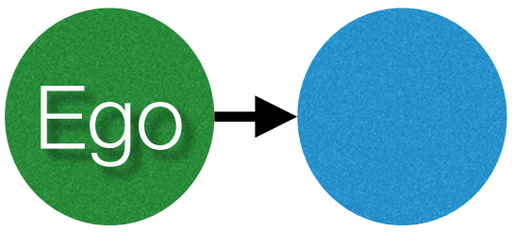
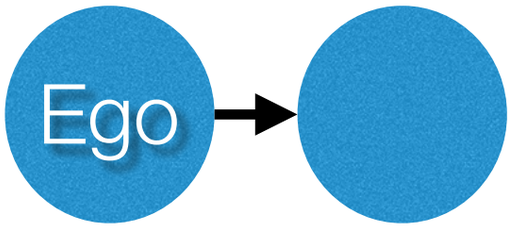
Basic Effects

t	*t+1*	Effect (RSiena term)	Preference
		Tendency (default)	main behavioral tendency

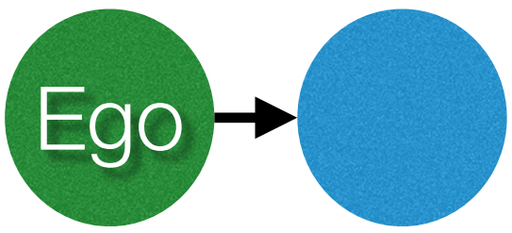
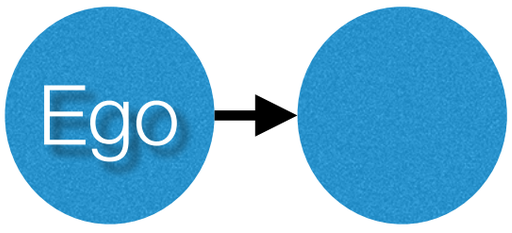
Basic Effects

t	*t+1*	Effect (RSiena term)	Preference
		Tendency (default)	main behavioral tendency to change to behavior of friends

Basic Effects

t	*t+1*	Effect (RSiena term)	Preference
		Tendency (default)	main behavioral tendency
		Similarity (avSim or totSim)	to change to behavior of friends

Basic Effects

t	*t+1*	Effect (RSiena term)	Preference
		Tendency (default)	main behavioral tendency
		Similarity (avSim or totSim)	to change to behavior of friends

Note the difference from SameX or SimX

Basic Effects

t	*t+1*	Effect (RSiena term)	Preference
		Similarity (sameX or simX)	for ties to similar alters
		Similarity (avSim or totSim)	to change to behavior of friends

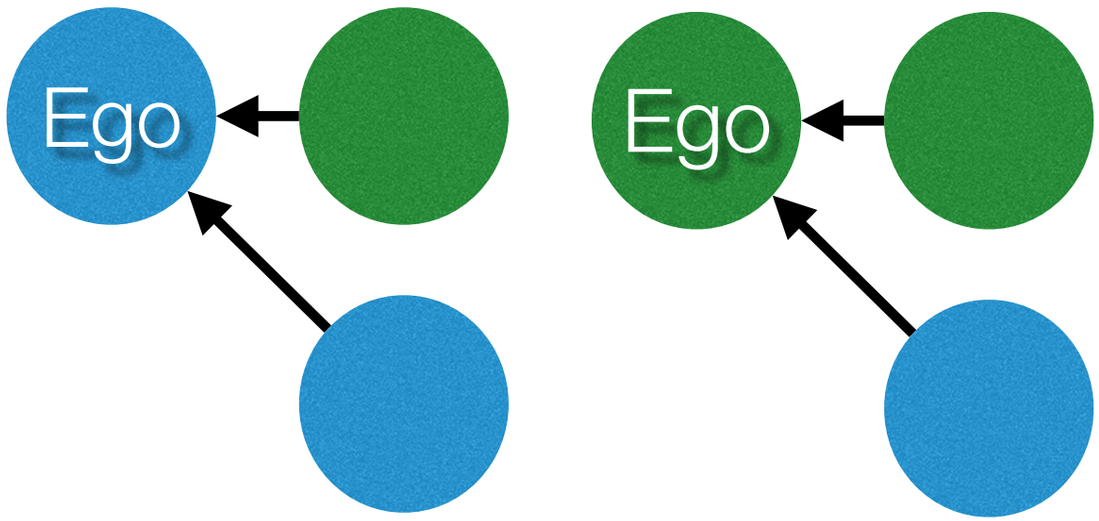
Interactions w/ Covariates

t	*t+1*	Effect (RSiena term)	Preference
			effect of popularity on behavior

Interactions w/ Covariates

t

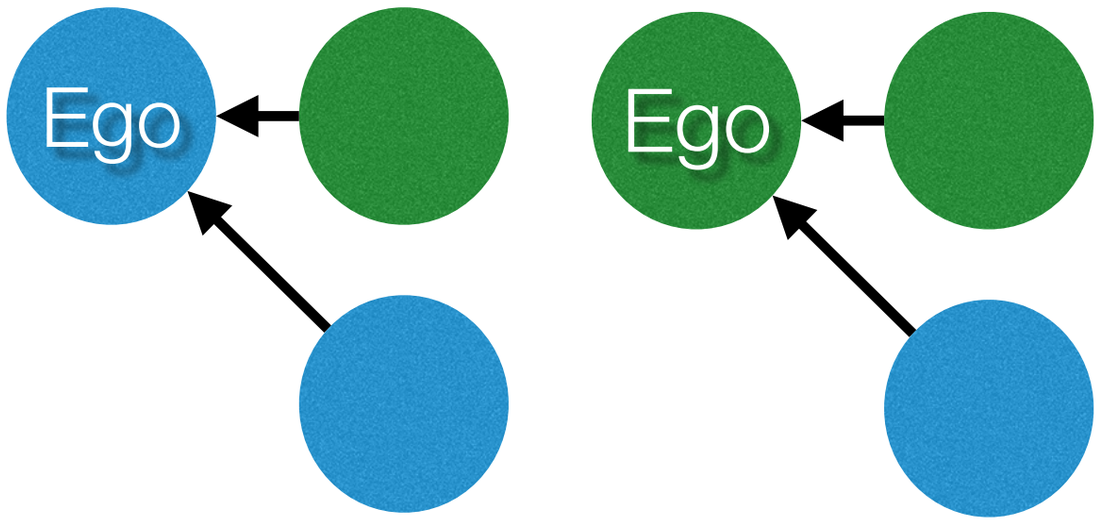
t+1



Effect (RSiena term)	Preference
Indegree (indeg)	effect of popularity on behavior

Interactions w/ Covariates

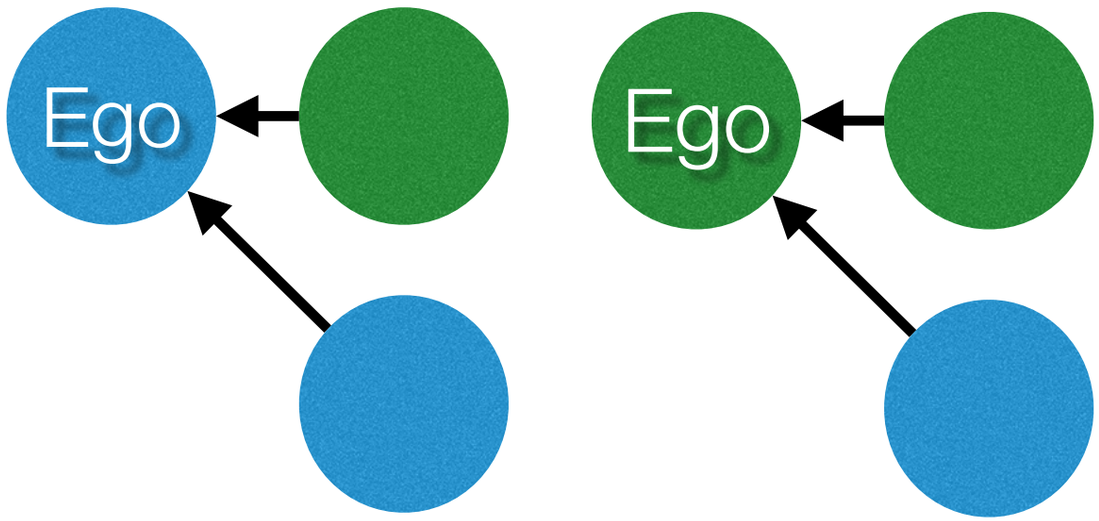
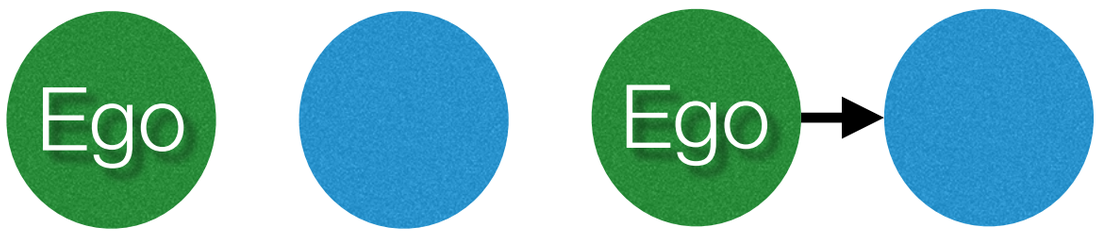
t *t+1*



Effect (RSiena term)	Preference
Indegree (indeg)	effect of popularity on behavior

Note the difference from AlterX

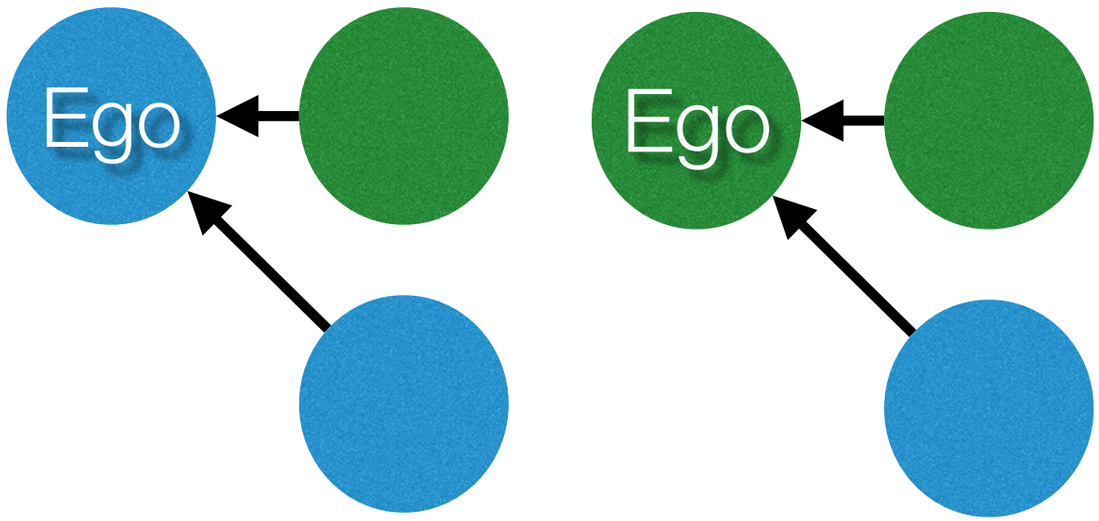
Interactions w/ Covariates

t	*t+1*	Effect (RSiena term)	Preference
		Indegree (indeg)	effect of popularity on behavior
		Behavior Alter (AlterX)	alter's covariate effect on preference

Interactions w/ Covariates

t

t+1

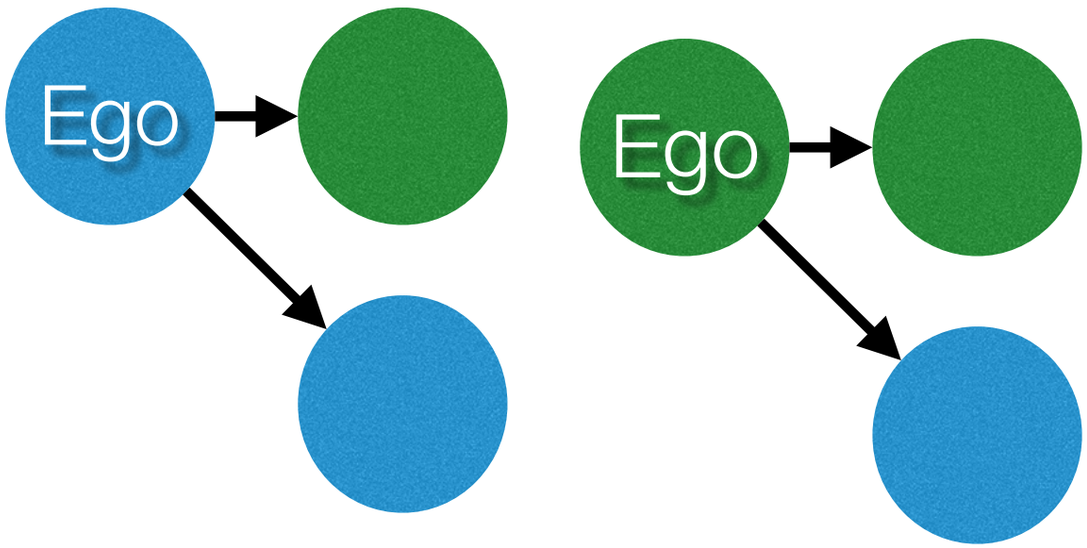


Effect (RSiena term)	Preference
Indegree (indeg)	effect of popularity on behavior

Interactions w/ Covariates

t

t+1



Effect (RSiena term)

Preference

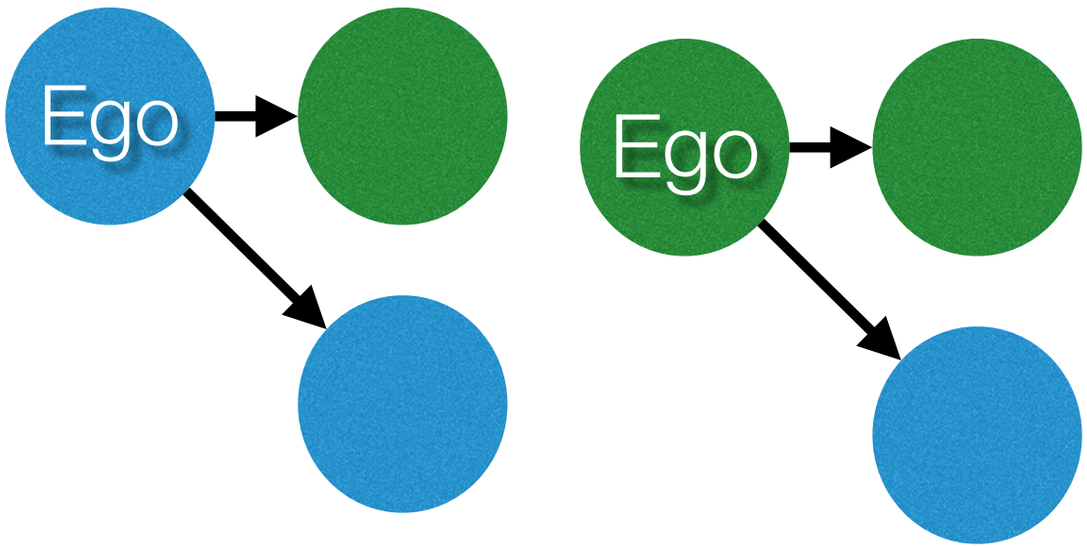
Outdegree (outdeg)

effect of activity on behavior

Interactions w/ Covariates

t

t+1

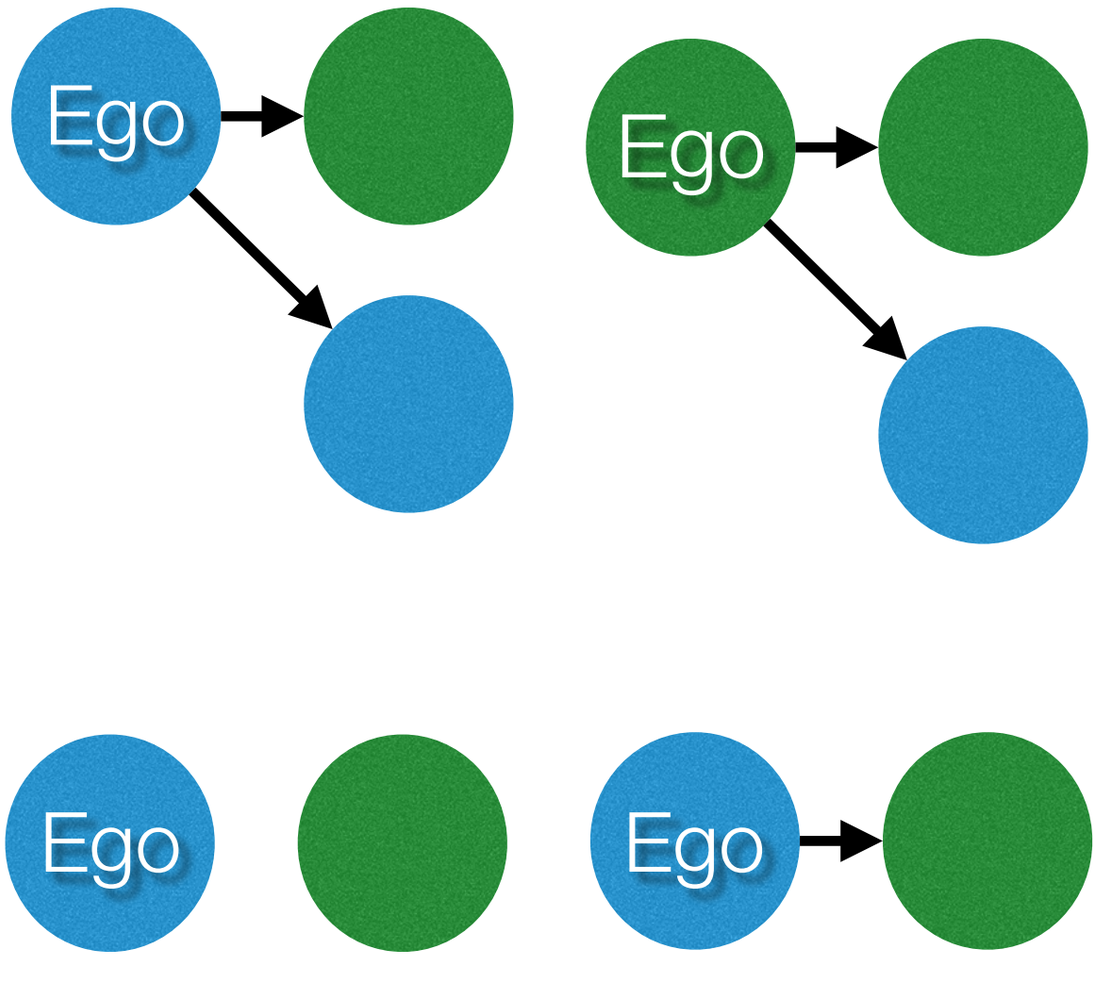


Effect (RSiena term)	Preference
Outdegree (outdeg)	effect of activity on behavior

Note the difference from EgoX

Interactions w/ Covariates

t *t+1*



Effect (RSiena term)	Preference
Outdegree (outdeg)	effect of activity on behavior
Behavior Ego (EgoX)	ego's covariate effect on preference

Learning Goals

- Understand the logic of the coevolution model.
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Questions?