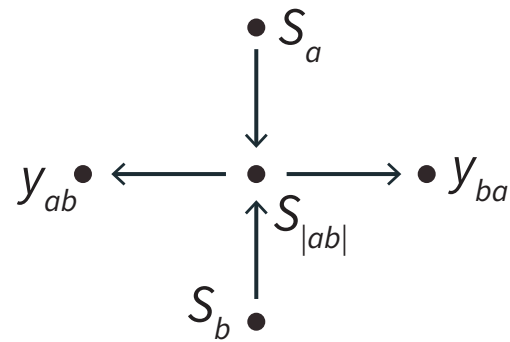
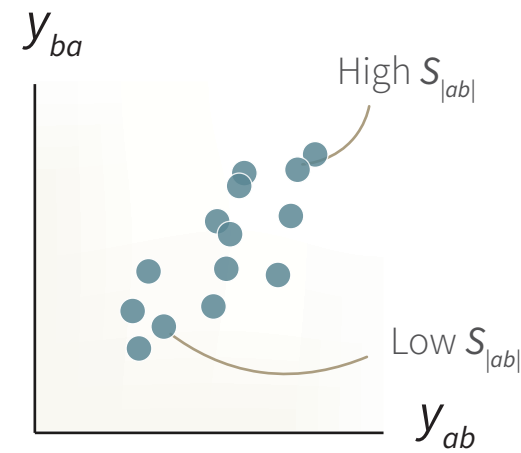


Causal process

A. Sampling effort

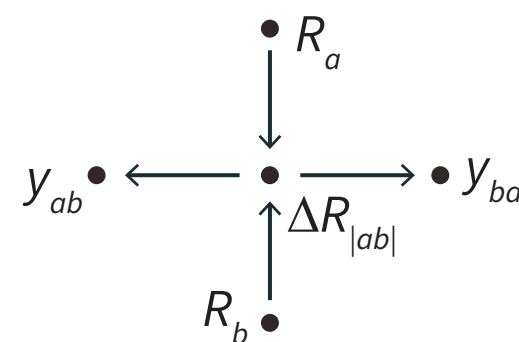


Statistical pattern

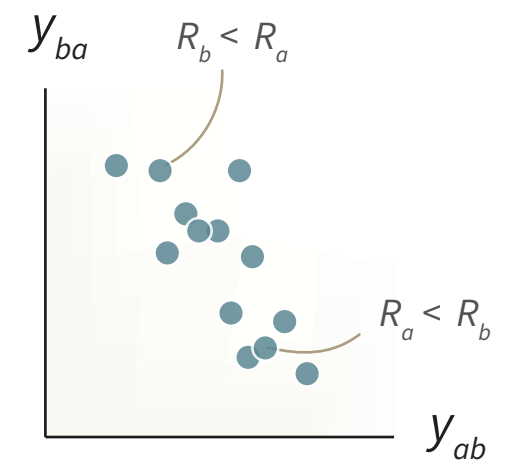


Causal process

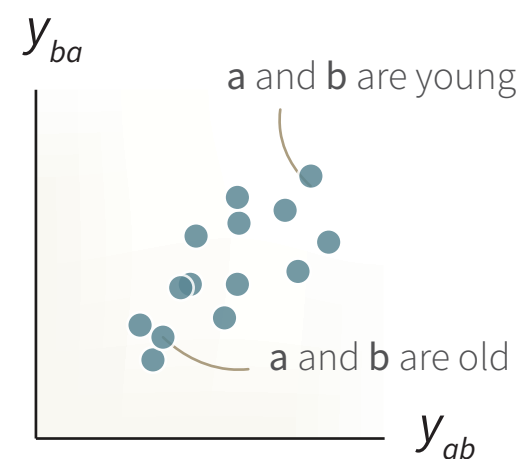
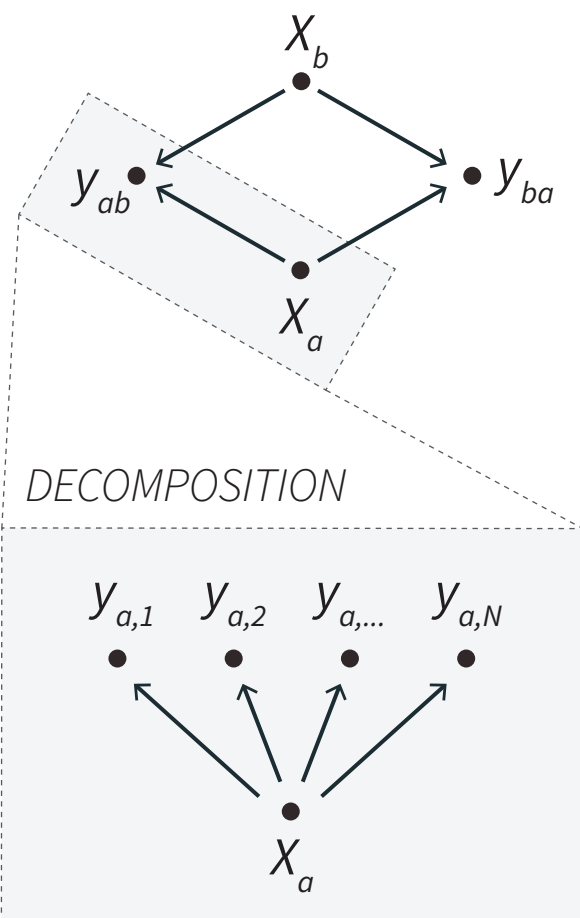
C. Dyad features (e.g., dominance)



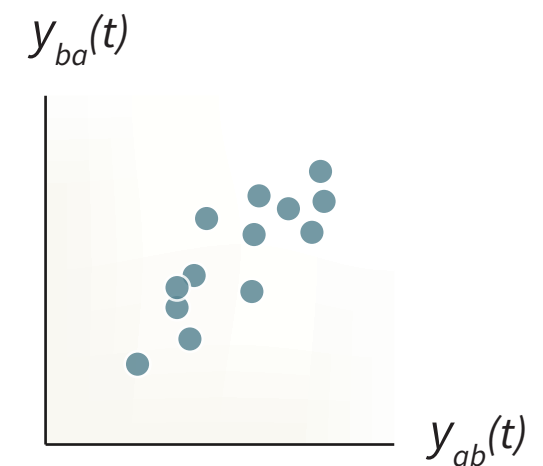
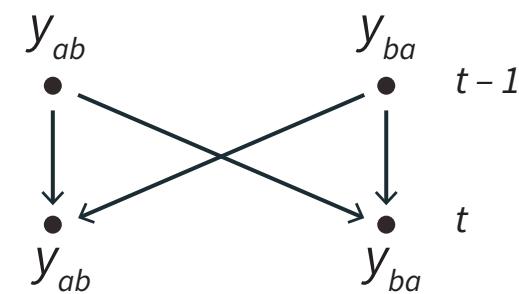
Statistical pattern



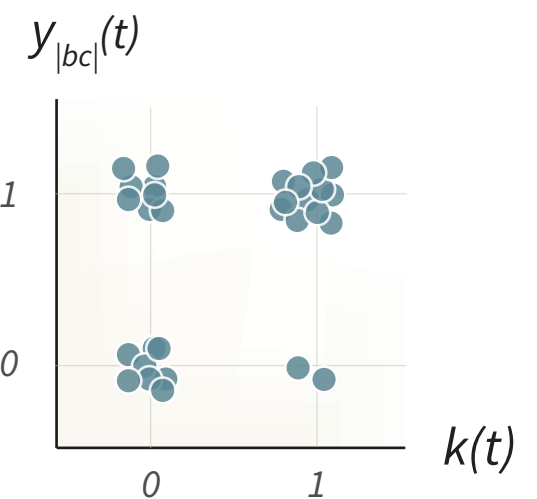
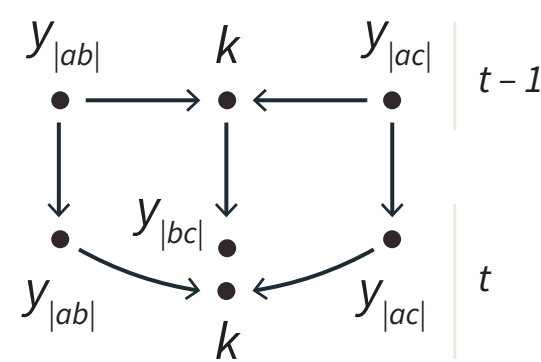
B. Individual features (e.g., age)



D. Dyadic reciprocity



E. Triadic closure



Causal diagram

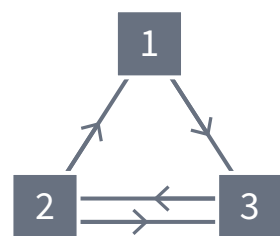
Causal assumptions



The *variable* X influences the *variable* Y

Social network

Social interactions among $N = 3$ individuals



Squares represent *individual* animals

a	b	y_{ab}	y_{ba}	X_a	X_b
1	2	0	1	2.1	4.8
1	3	1	0	2.1	7.0
2	3	1	1	4.8	7.0

Variables

a, b Identifier *variable*

y_{ab} Observed interactions from a to b

y_{ba} Observed interactions from b to a

$y_{a,1}$ Observed interactions from a to 1

$y_{a,N}$ Observed interactions from a to N

$y_{|ab|}$ Undirected edge between a & b

S_a, S_b Individual-level sampling effort

$S_{|ab|}$ Dyad-level sampling effort

X_a, X_b Individual-level trait (e.g., age)

R_a, R_b Dominance rank

$\Delta R_{|ab|}$ Difference in rank between a & b

$$k(t) = y_{|ab|}(t) \times y_{|ac|}(t)$$