Agglomeration Bonus with Transaction Costs: An Examination of Spatial Coordination

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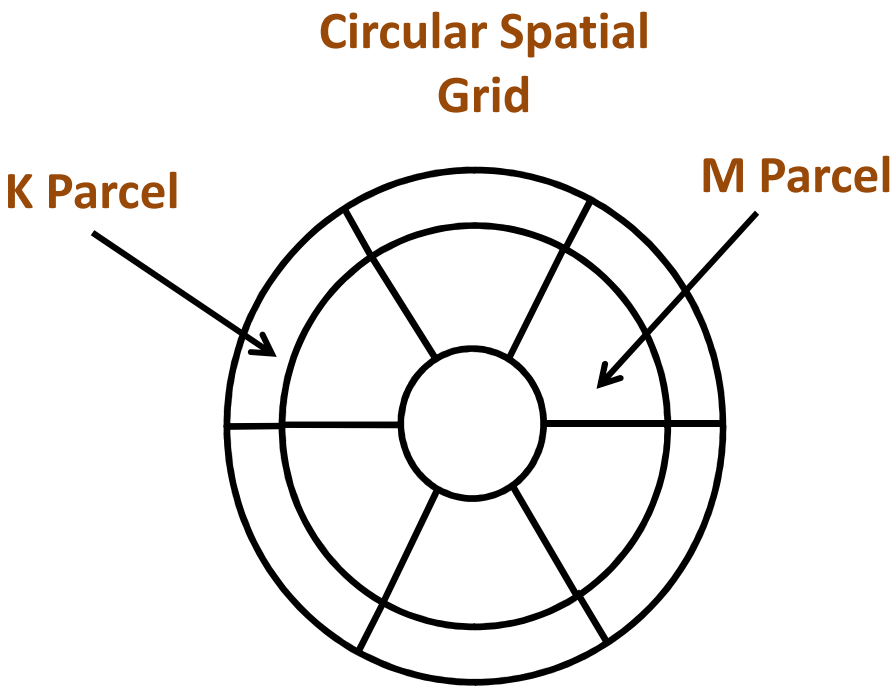
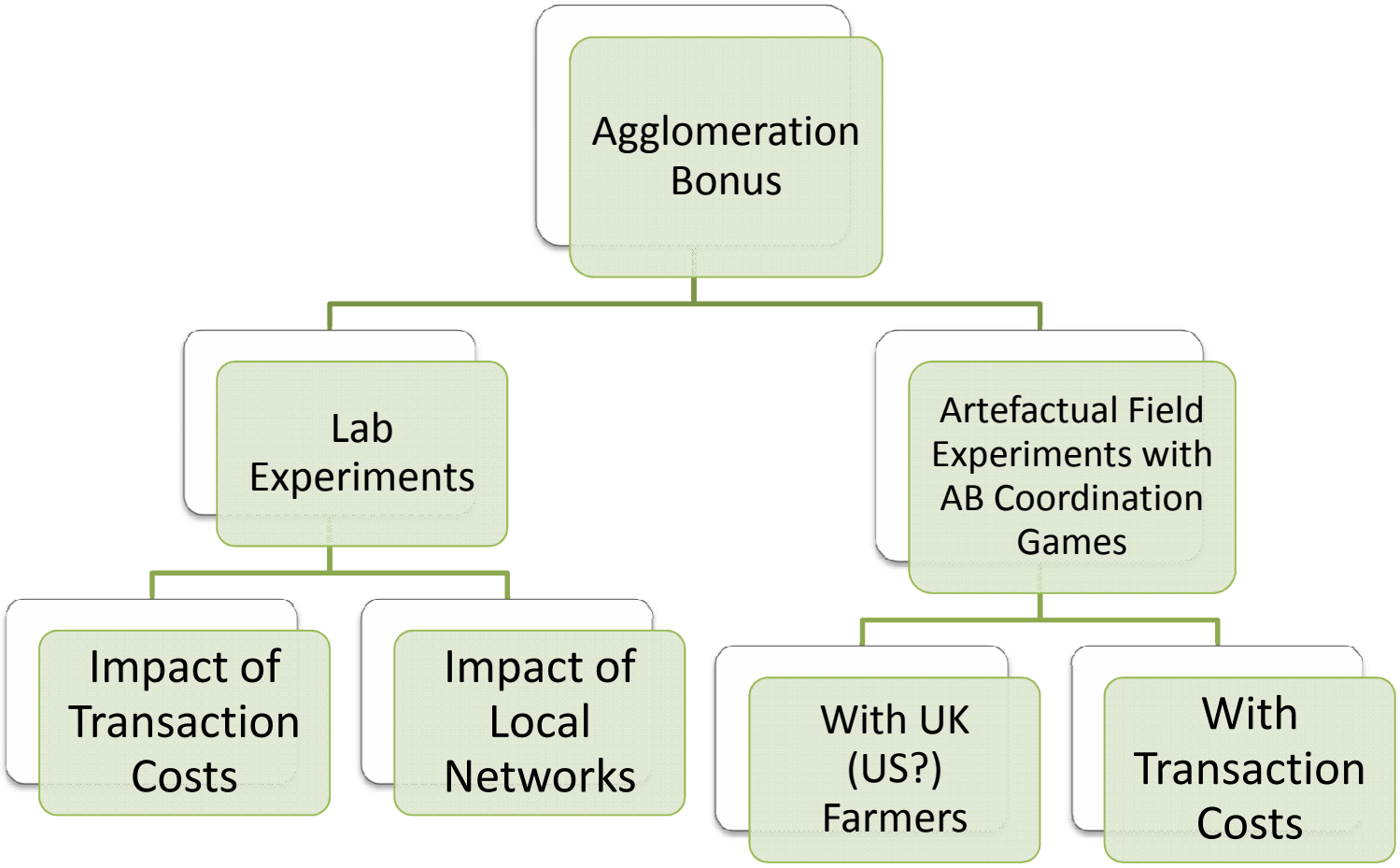
Agglomeration Bonus

- **Two part payment**
  - Participation component & Bonus
  - Strategic environment is a coordination game
  - Game has Pareto ranked Nash Equilibria (NE)
  - Selection criteria: **payoff** & **risk** dominance can select the same NE or different NE (Harsanyi & Selten 1987)

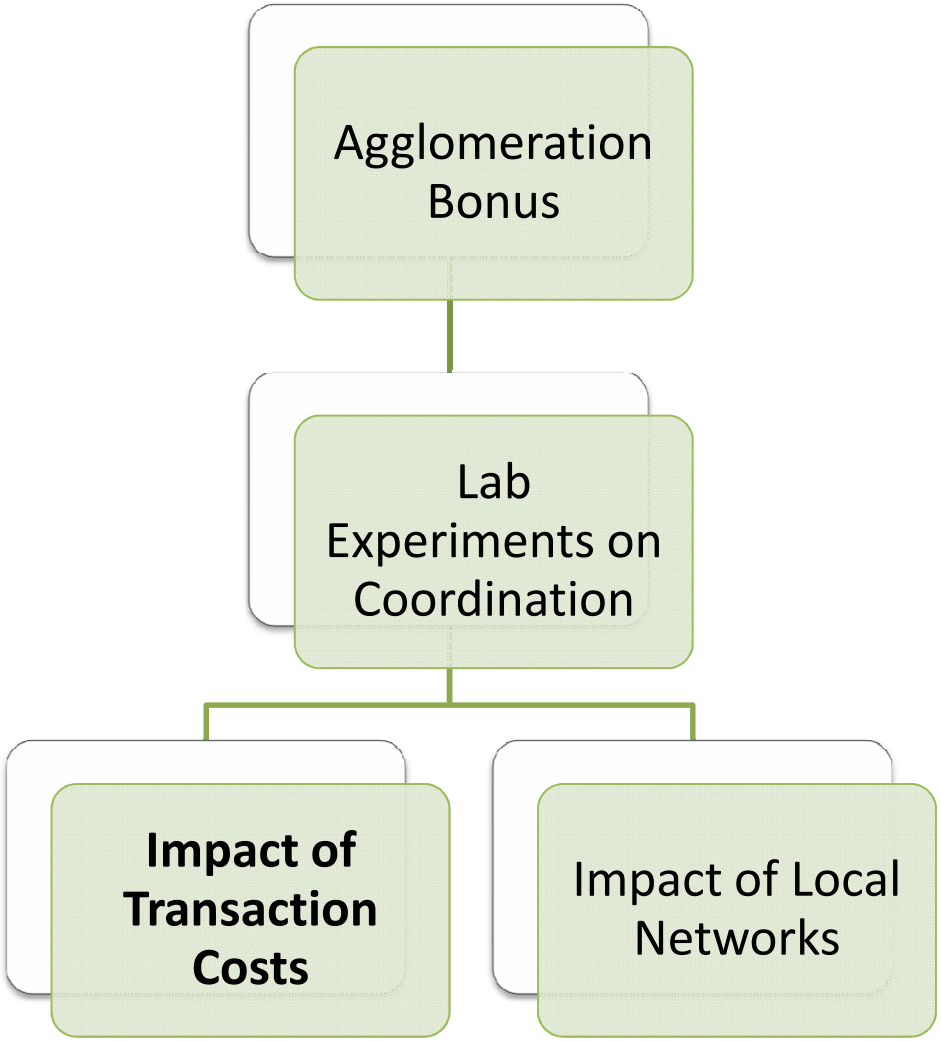
- **Lab experiments indicate**
  - **Repetition** & **communication** leads to coordination on ecologically desirable outcome (Parkhurst et al. 2007, Warziniack et al. 2007)
  - Coordination failure however possible given **riskiness** associated with coordination
  - Coordination to risk dominant outcome more likely in **larger** groups than **smaller** ones (Van Huyck et al. 1990)
  - Size effect true for both closed & open groups (Berninghaus et al. 2003)



Objective: Experimental Examination



Objective: Experimental Examination



Study Motivation

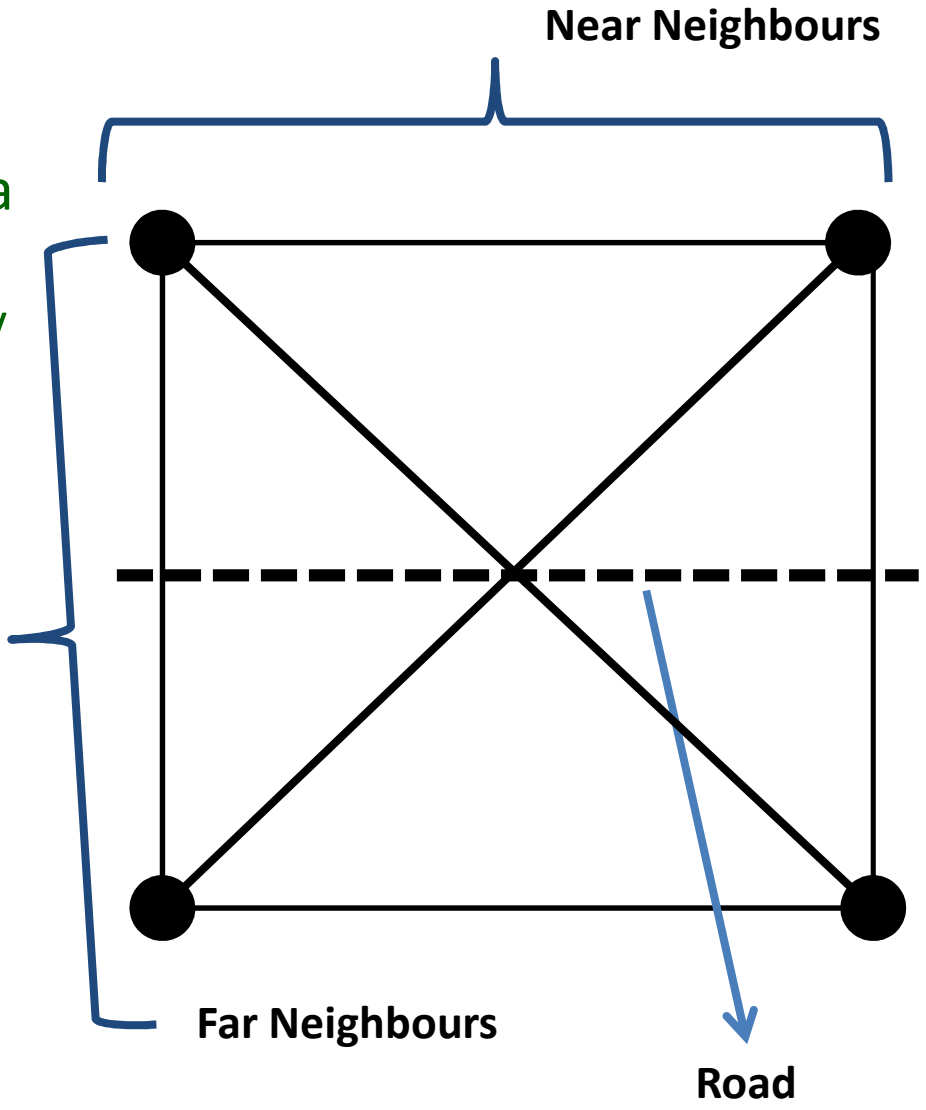
- **Transaction costs (TC) of Agri-environmental scheme (AES) participation**
  - Form a large part of AES (Mettepenningen et al. 2009)
  - Includes costs of setting up land management plans, attending meetings & information sessions, coordinating with neighbours (for spatial goal), monitoring outcomes
  - Increased targeting of AES increases TC (Ollikainen et al. 2008)
  - STEWPOL study found that farmers in Sweden & Germany did not participate in AES owing to high TC of participation (Falconer 2000) – **holdout problems**

Objective: Examine AB Performance

- Consider a new AB game environment with TC
- Analyze features of new AB game
- Evaluate impact of increasing the value of TC on features of the AB game
- Consider spatial coordination on simulated landscape with local interactions

New AB Environment

- Landscape has even number of farms
- Two farms each on one side of a mobility barrier (road)
  - Roads can hinder species mobility between habitats
- Payments for two types of Ecosystem Services (ES)
  - Connectivity based (C) ES : improved habitat connectivity for amphibians
  - Distance based (R) ES : increase in habitat for pollinators
- Farms on same side of road are near neighbours (n_p)& far neighbours (n_f) otherwise
  - Every farm has 3 neighbours



AB Payoffs

$$u_i(\sigma_i, \sigma_{-i}) = s(\alpha) + \{(1+d)n_p(\alpha) + n_f(\alpha)\}b(\alpha) - \{(1+d)n_p + n_f\}T(\alpha) + \pi(\alpha)$$

- s(α) is participation payment & b(α) is bonus for strategy α=C,R,X
  - s(C)>s(R)
  - b(C)>b(R)
- T(α) is transaction cost associated with delivery of ES α
  - T(C)>T(R)
- d={0,1} & d=1 if α=C, 0 otherwise
  - Represents higher TC of creating connected habitats
  - Higher bonus payments for similar land uses/connected patches on same side of mobility barrier
- π(x) > π(R) > π(C)
  - Income from non-participation higher than income (not total payoffs) from agriculture when participating in AB scheme

AB Game

- Two pure strategy Nash Equilibria
  - σ_i=C & σ_i=R for all i
- When T(C)=0=T(R)
  - Risk & payoff dominance select same strategy profile σ_i=C
  - Non-participation is a strictly dominated strategy
  - Repeated or one-shot interactions should lead to coordination to the high paying ecologically beneficial outcome

Illustrative Example: TC=0

Parameters

S(C)	S(R)	b(C)	b(R)	T(C)	T(R)	np	nf	π(R)	π(R)	π(x)
25	20	20	8	0	0	1	2	100	110	120

Neighbors' Choices

Player's choice	CCC	CRC	CRR	RCC	RRC	RRR
C	**205**	185	165	165	145	125
R	130	138	146	138	146	**154**
X	120	120	120	120	120	120

- Two Pure Strategy Nash Equilibria
- Deviation loss for C=75; R=29
- Payoff Dominance and Risk Dominance select same Strategy C
- Non-participation (X) strictly dominated

Illustrative Example: TC>0

Parameters

S(C)	S(R)	b(C)	b(R)	T(C)	T(R)	np	nf	π(R)	π(R)	π(x)
25	20	20	8	5	3	1	2	100	110	120

Neighbors' Choices

Player's choice	CCC	CRC	CRR	RCC	RRC	RRR
C	**185**	165	145	145	125	**105**
R	**121**	129	137	129	137	**145**
X	120	120	120	120	120	**120**

- Two Pure Strategy Nash Equilibria
- Deviation Loss for C= 64; for R=40
- Payoff Dominance & Risk Dominance select **same** Strategy C
- Non-participation (X) strictly dominated by R only
- Scenario similar to coordination game in CDFR(1990)

Illustrative Example: TC>0

Parameters

S(C)	S(R)	b(C)	b(R)	T(C)	T(R)	np	nf	π(R)	π(R)	π(x)
25	20	20	8	10	3	1	2	100	110	120

Neighbors' Choices

Player's choice	CCC	CRC	CRR	RCC	RRC	RRR
C	**165**	145	125	125	105	85
R	121	129	137	129	137	**145**
X	120	120	120	120	120	120

- Two Pure Strategy Nash Equilibria
- Deviation Loss for C= 44; for R=60
- Payoff Dominance & Risk Dominance select **different** strategies
- Non-participation (X) strictly dominated by R only
- Scenario different from CDFR(1990)

Illustrative Example: TC>0

Parameters

S(C)	S(R)	b(C)	b(R)	T(C)	T(R)	np	nf	π(R)	π(R)	π(x)
25	20	20	8	15	5	1	2	100	110	120

Neighbors' Choices

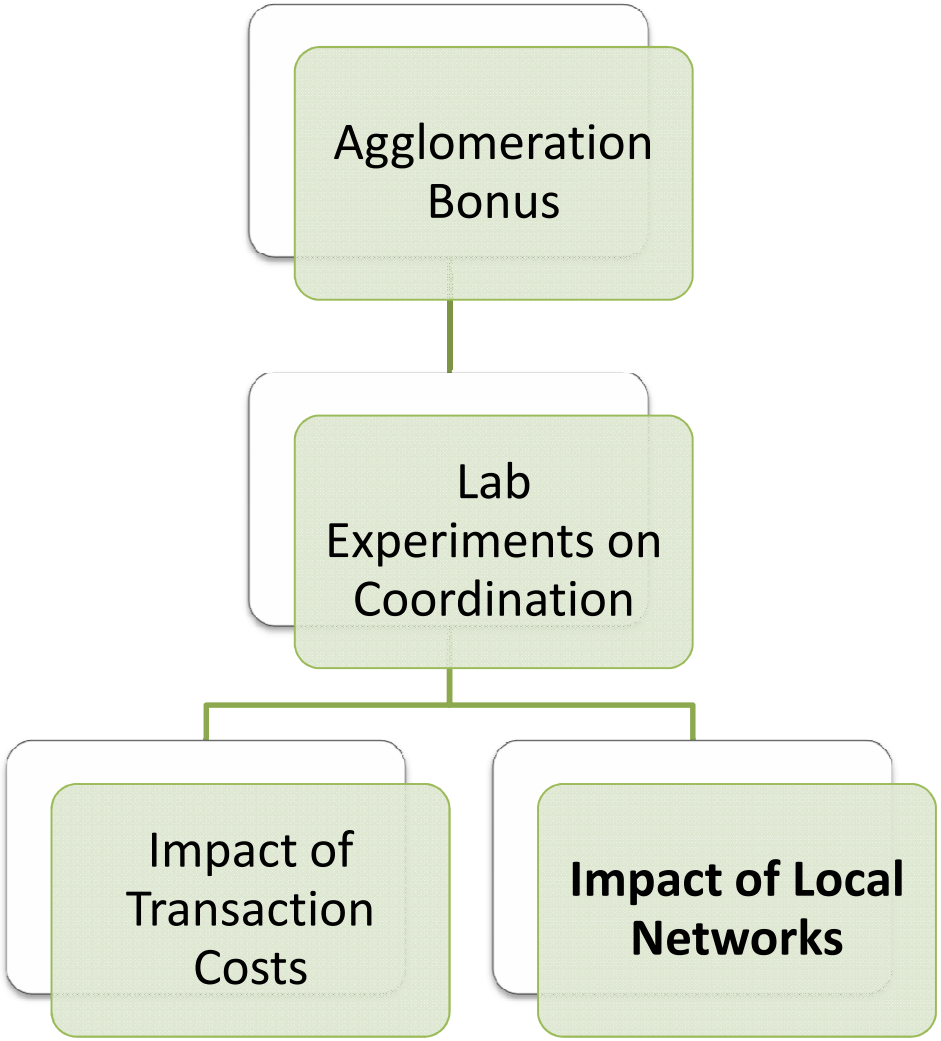
Player's choice	CCC	CRC	CRR	RCC	RRC	RRR
C	**145**	125	105	105	85	65
R	**115**	123	131	123	131	**139**
X	**120**	120	120	120	120	120

- Two Pure Strategy Nash Equilibria
- Deviation Loss for C= 30; for R=74
- Payoff Dominance & Risk Dominance select different strategies
- Non-participation (X) no longer strictly dominated
- Scenario different from CDFR(1990)

Transaction Costs & Coordination

- As value of TC increases
  - Non-participation does not remain strictly dominated by C
    - Scenario similar to CDFR (1990)
    - Even if RD & PD select same strategy, repeated interaction may not choose Pareto efficient Nash Equilibrium
  - RD & PD may not select the same strategy
    - Likelihood of coordination failure intensified (Straub 1995)
  - Non-participation is no longer dominated by both C or X
- Thus with TC, possibility of coordination failure & holdouts intensified

Objective: Experimental Examination

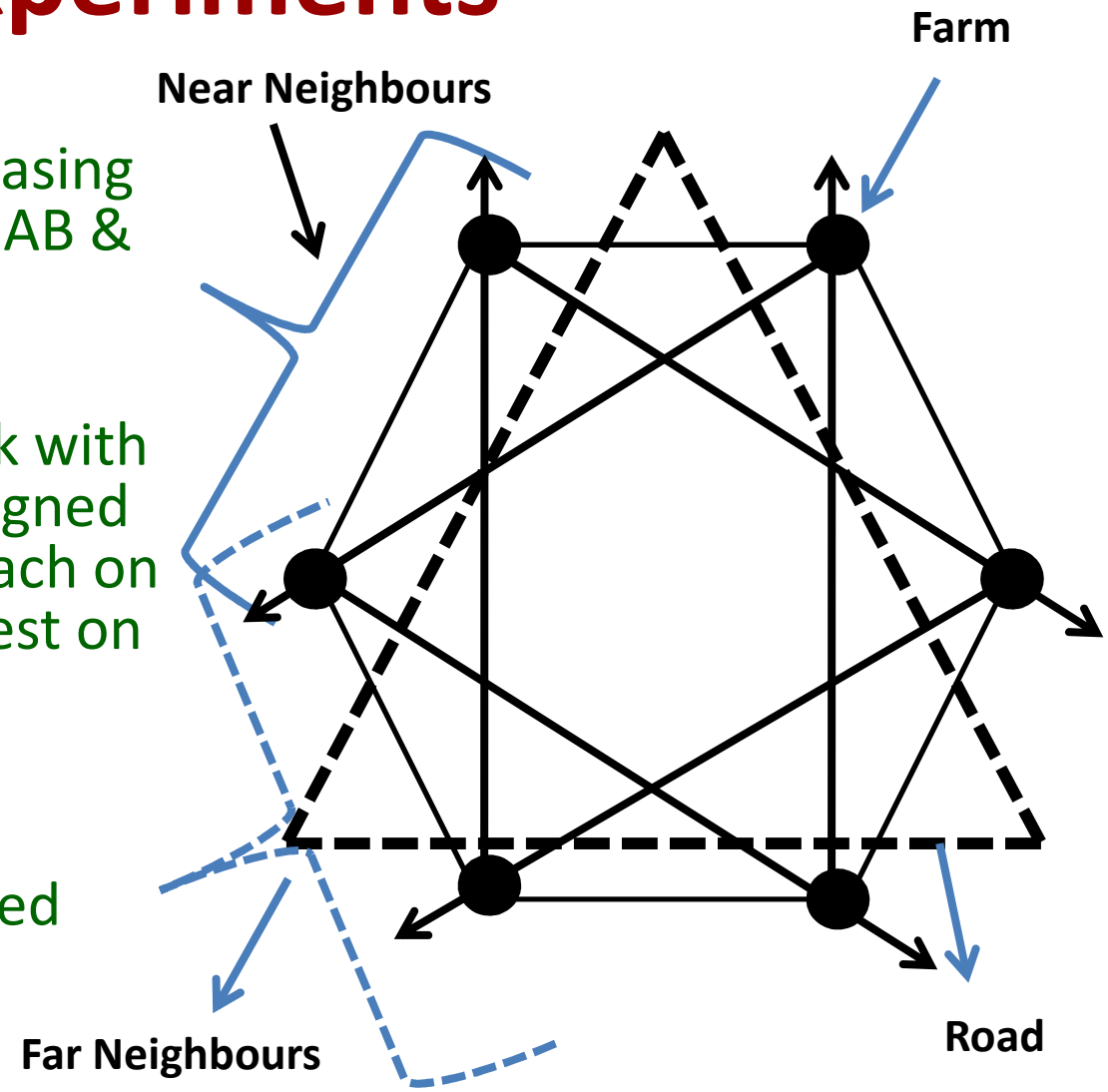


Next Steps

- **Local Interactions & Coordination Failure**
  - Interactions on Local networks when every individual interacts with a subset of individuals in group
  - Closed networks part of traditional set up where every player interacts with others
  - Level of **anonymity** higher in local networks as players may not share common neighbours
  - **Coordination failure common** in anonymous local networks relative to non-anonymous closed ones

Experiments

- To test impact of increasing TC on performance of AB & individual behaviour
- Consider local network with 6 players and roads aligned such that two farms each on one side of a road & rest on other side
- Every player has 3 neighbours like in closed network



Experiments

- Use student subjects in controlled lab environments with minimal contextual information
- Consider a combination of within & between treatments
  - Within treatments: increasing value of TC
  - Between treatments: nature of the network (open and closed)

Thank you

Questions