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European Commission
Horizon 2020
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Feed-a-Gene

Get Insight to Agonistic Behavior in Pigs using Social Network Analysis

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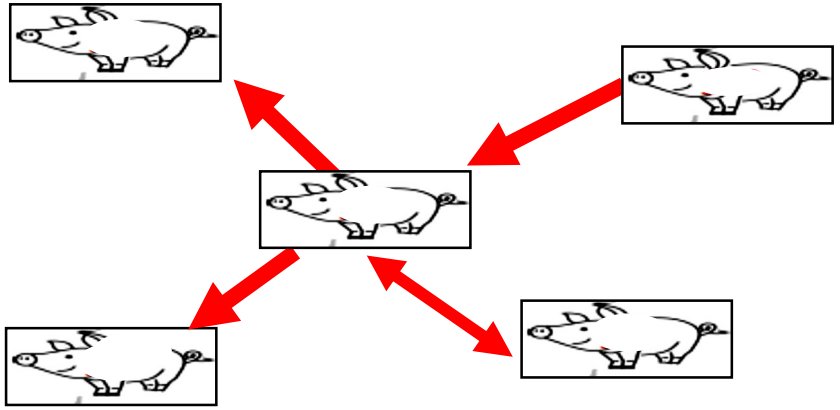
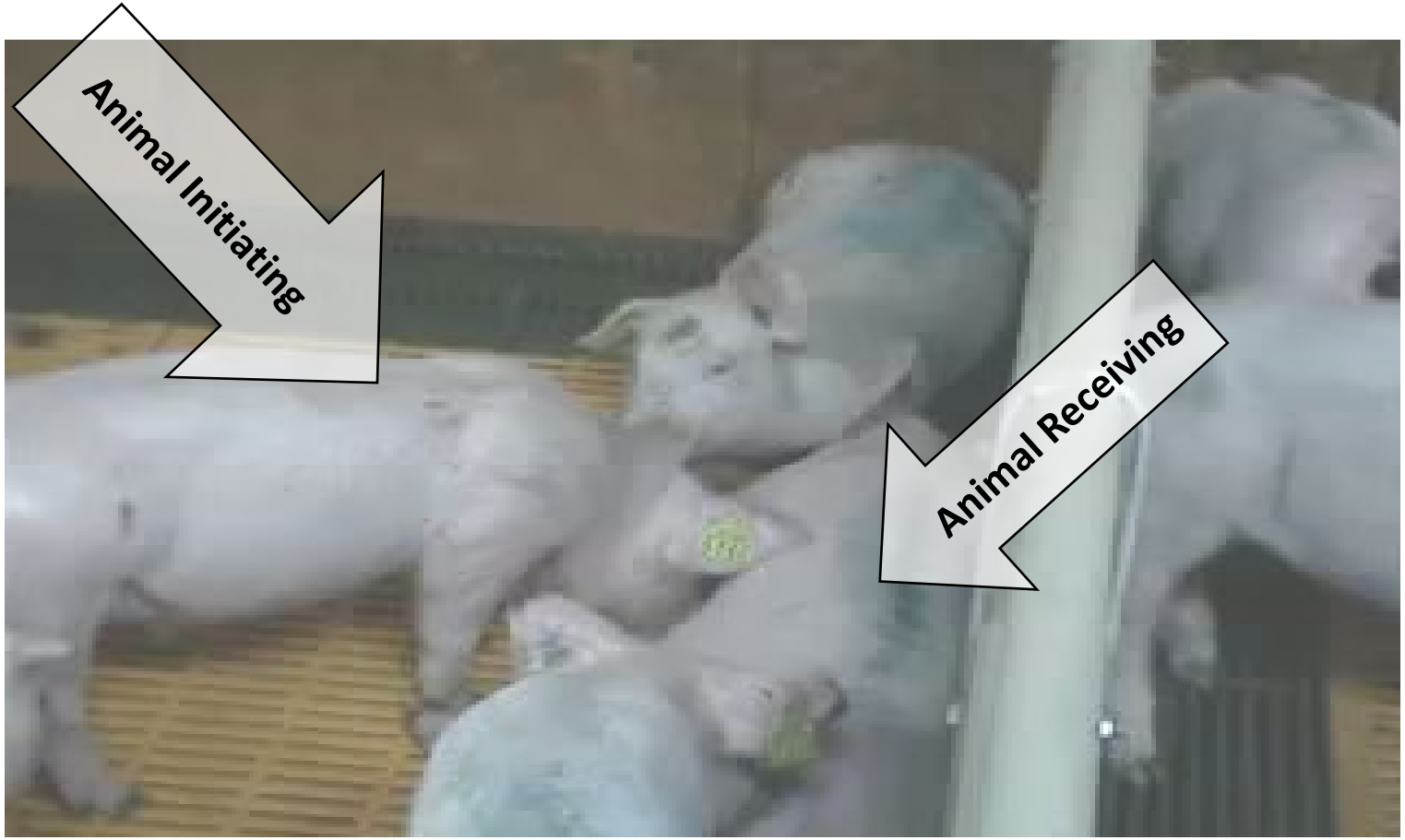


Agonistic Behavior

Agonistic Behavior has several negative consequences on welfare and production of pigs.

Types of
Agonistic Behavior??

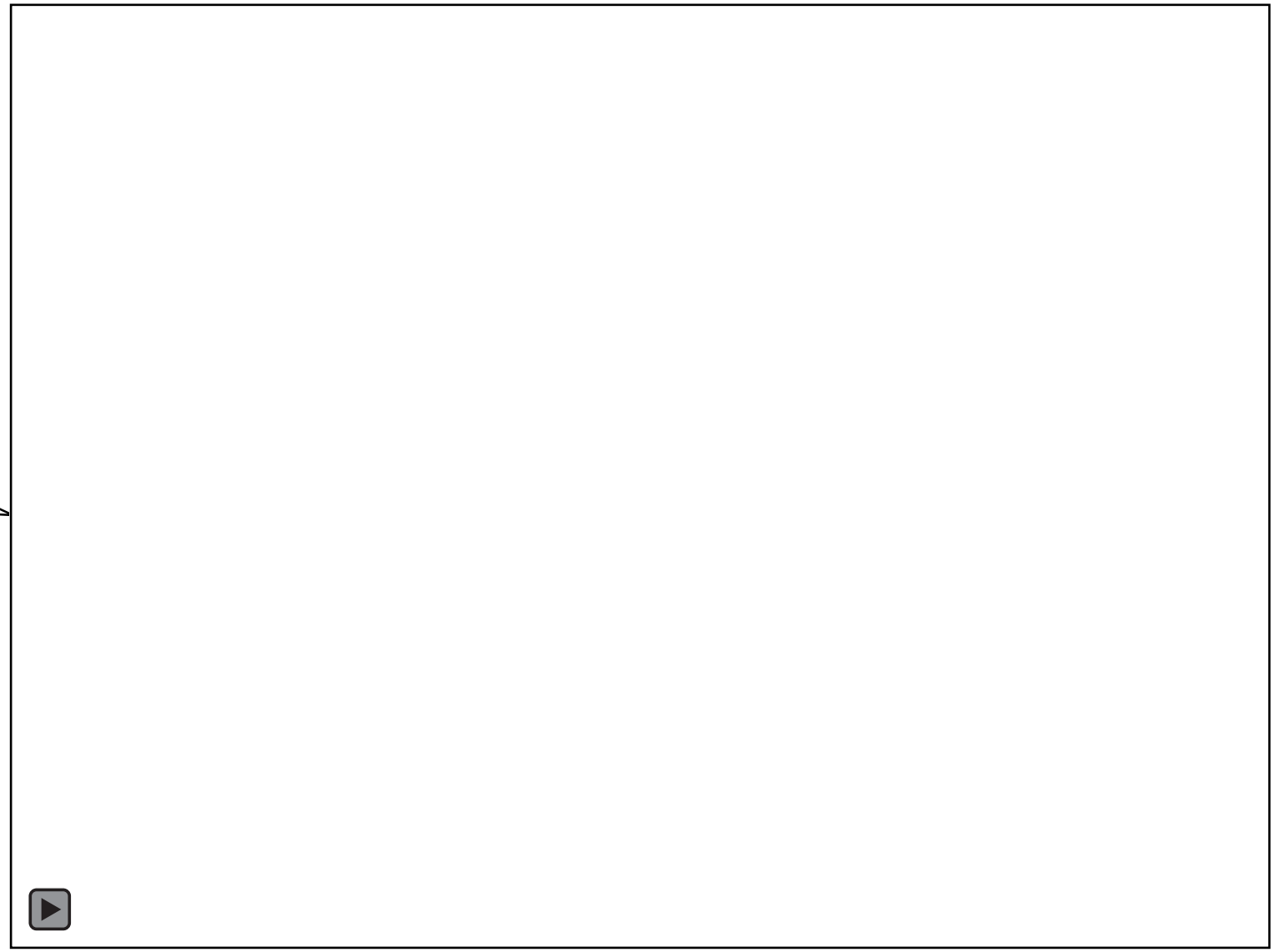
Fighting Behavior



Animal Ini

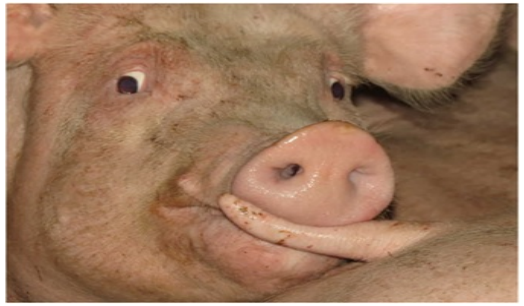
Tail-Bite Behavior

Head Knocking Behavior



Registration of Agonistic Behaviour

Fight



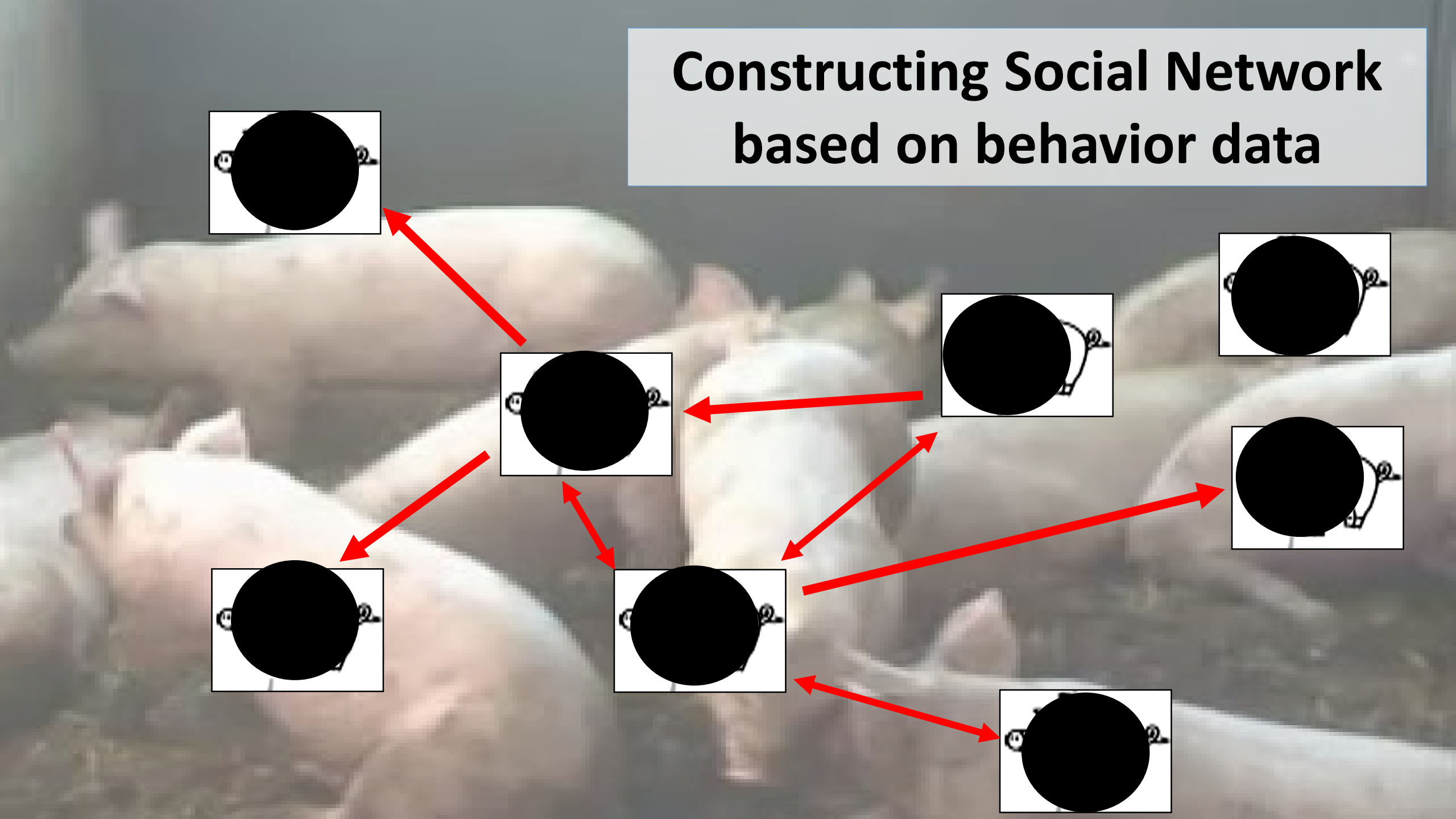
Tail-Bite

Head Knocking

Animal Initiated	Animal Received	Total Aggression
151	162	1
151	2129	1
151	2130	1
151	2131	1
152	151	1
152	175	1
152	2127	1
163	151	**2**
163	152	1
163	176	2
175	2127	1
175	2129	1
176	163	1
176	2127	**2**
2110	2129	1
2127	152	2
2127	163	1

- 332 pigs were registered.
- 29 pens.
- 10-15 animals/pen.

Constructing Social Network based on behavior data

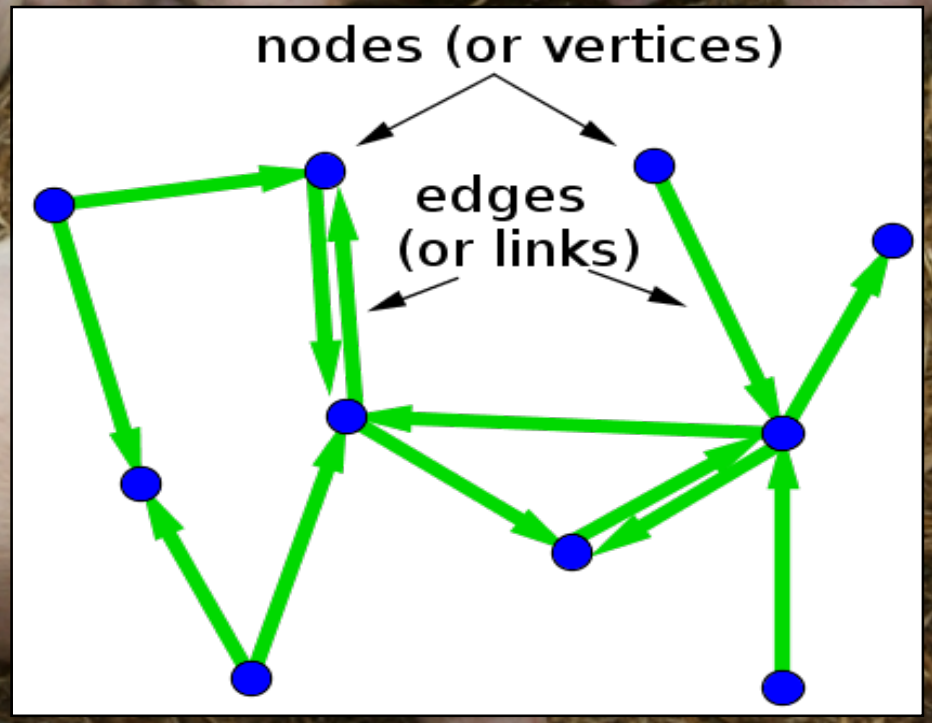


Social Network Analysis (SNA)

SNA is an approach that quantifies the pattern of relationships among interacting individuals.

SNA graph is composed of:

- **Node (Vertex)**
  Represents an individual in a network.
- **Edge (Links)**
  Interaction between two nodes.
- **Edge direction**
  From the individual "Initiating" to the individual "Receiving" the action.



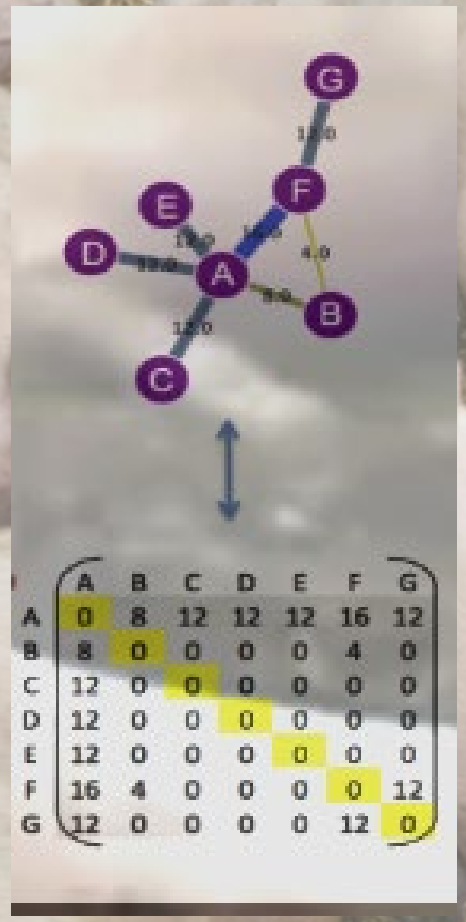
Social Network Analysis (SNA)

Behavior Data

SNA

R

igraph



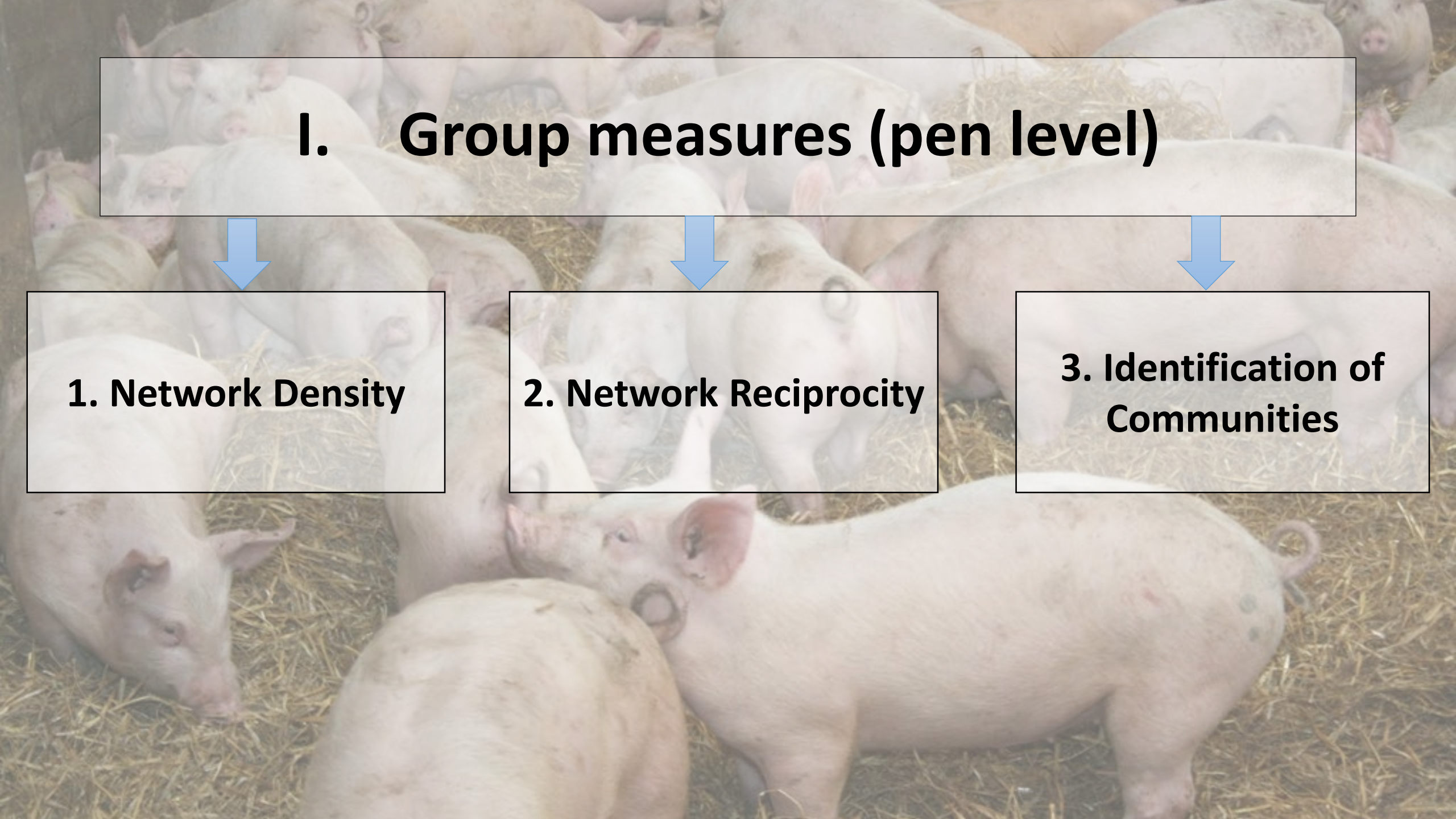
SNA

Network Statistics

I. Group (Pen) Level

II. Individual level

New Behavior Traits



I. Group measures (pen level)

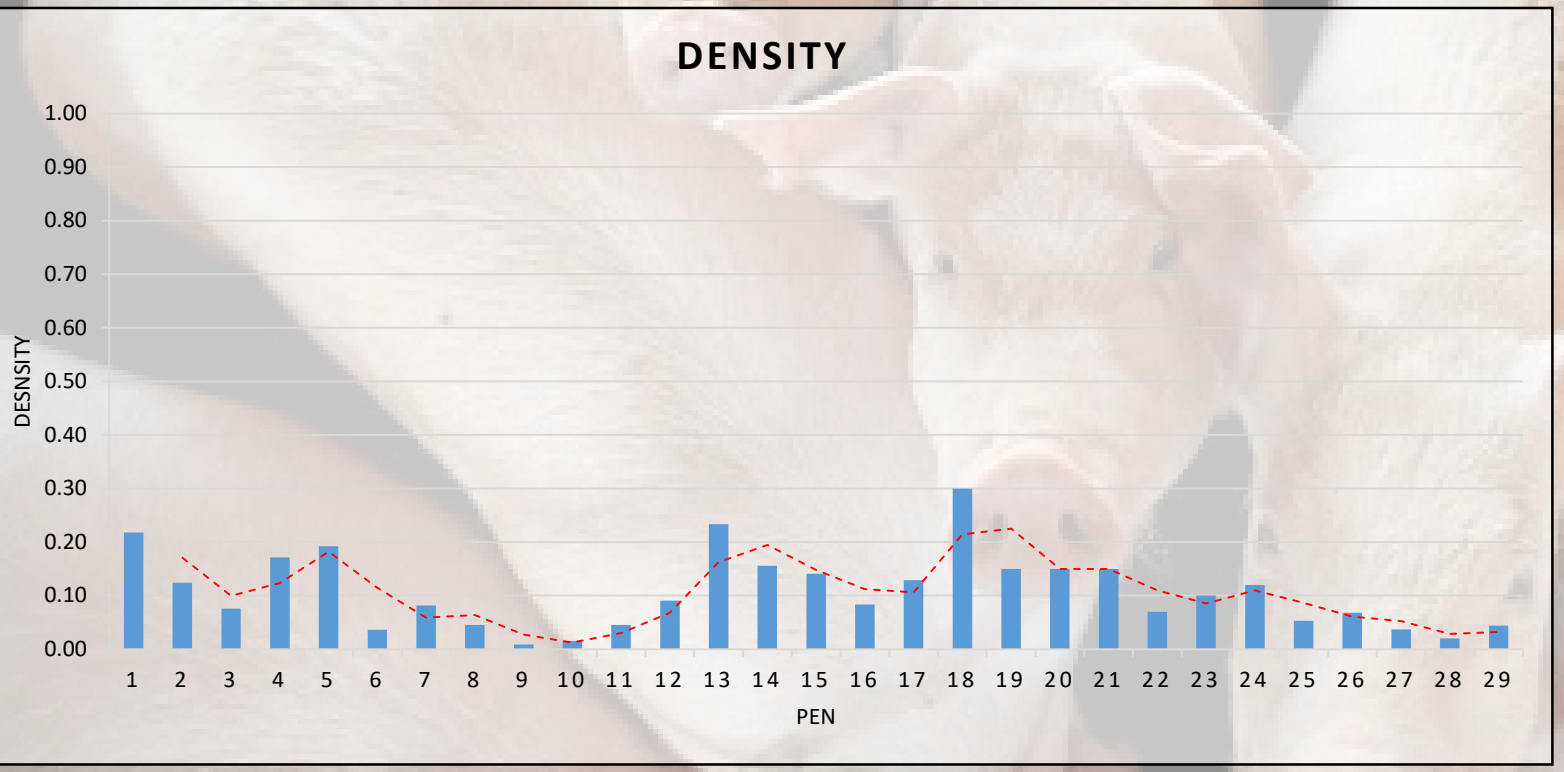
1. Network Density

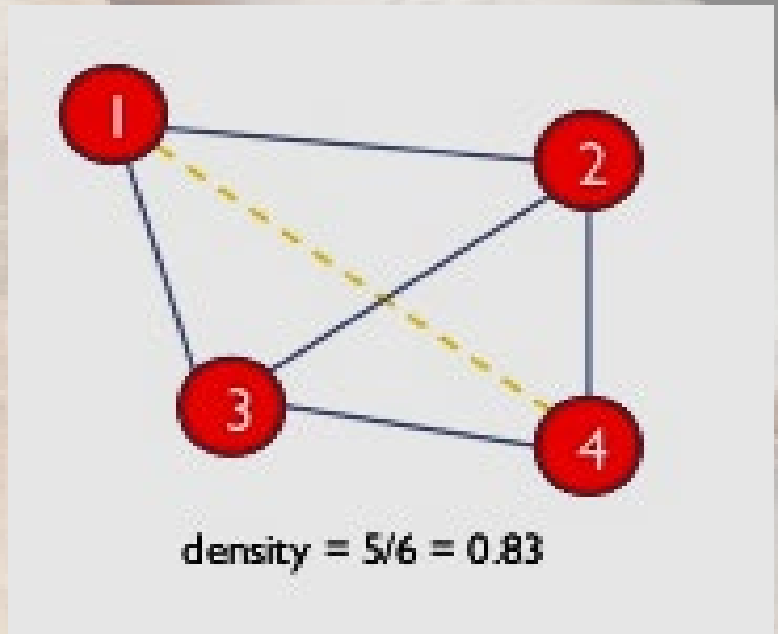
2. Network Reciprocity

3. Identification of Communities

1-Network Density

The number of observed edges divided by the number of possible edges in the network.

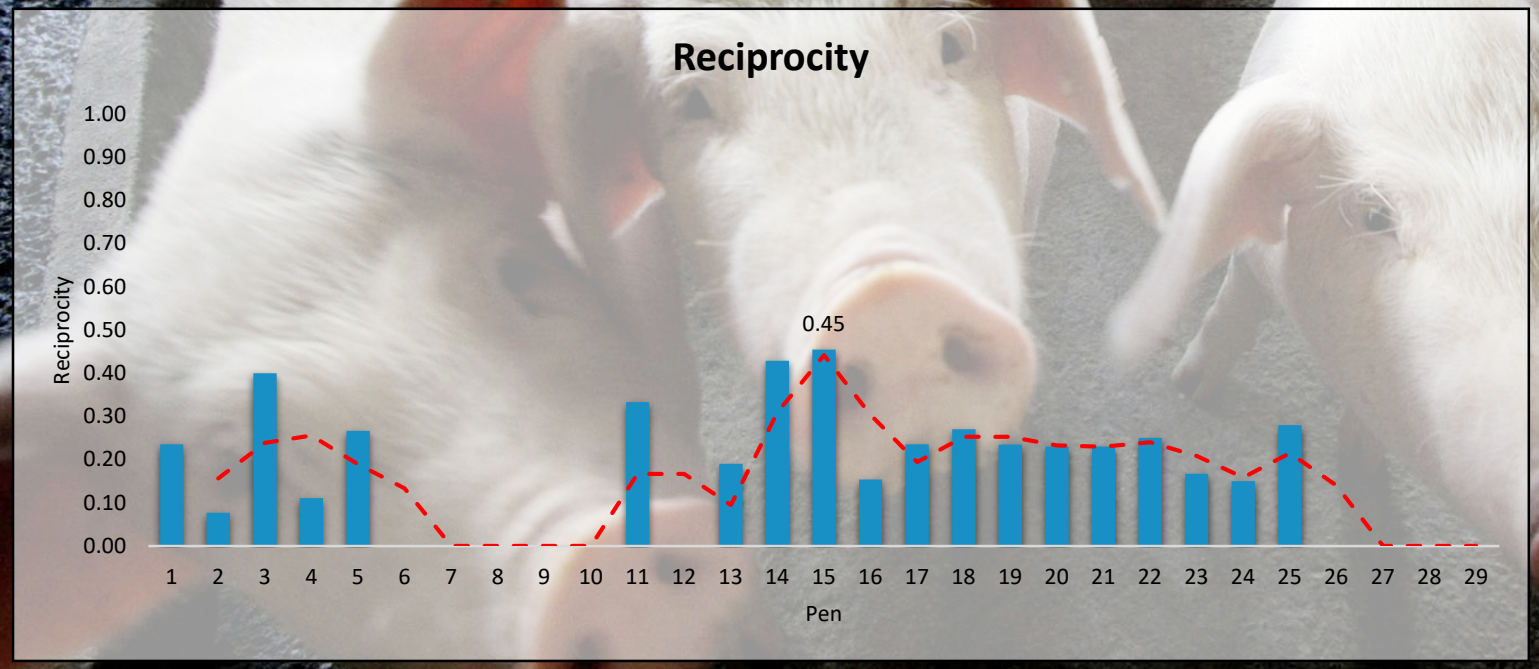


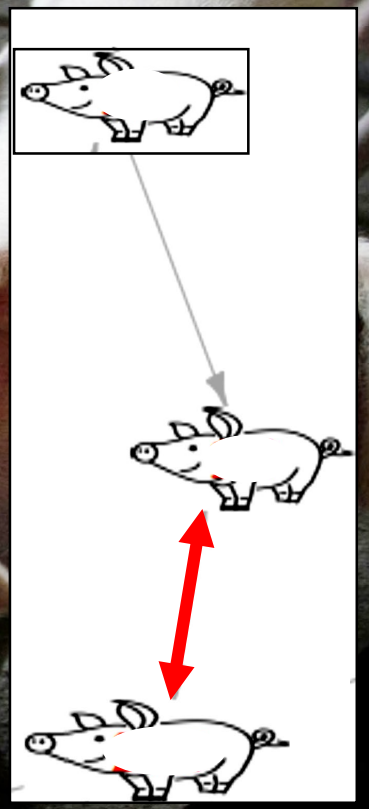


The higher the density, the more aggressive the group (Max = 1)

2-Network Reciprocity

The ratio of the number of pairs with a reciprocated action relative to the number of pairs with any action.



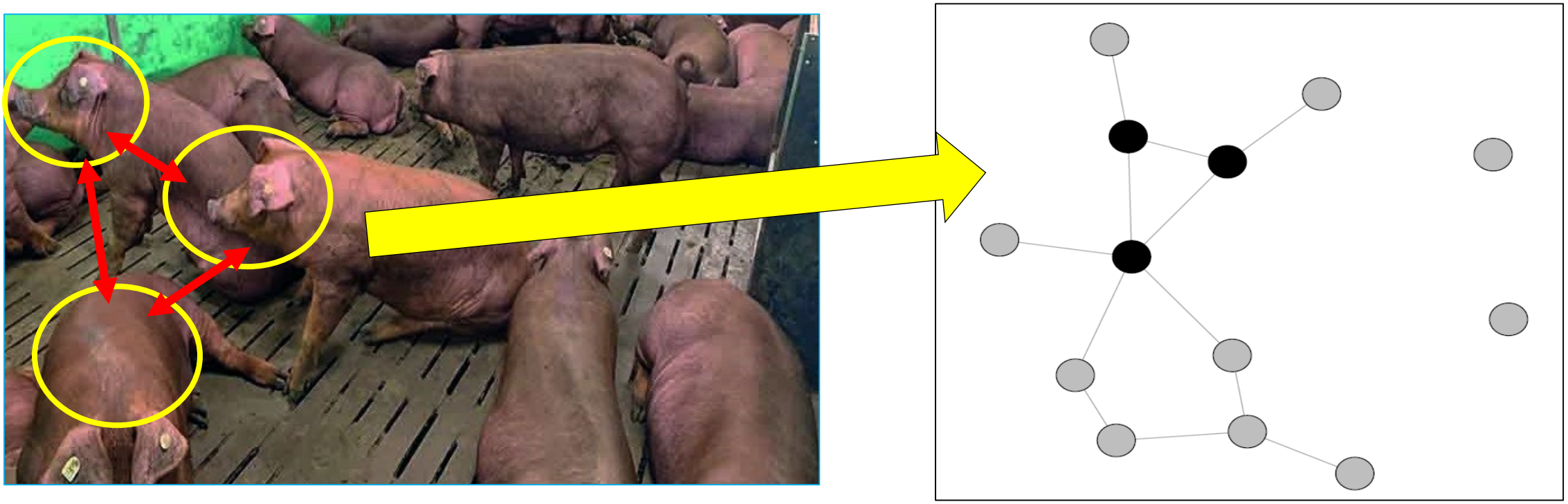


Reciprocity = 0.5

3. Identification of Communities

1- Clique of Animals

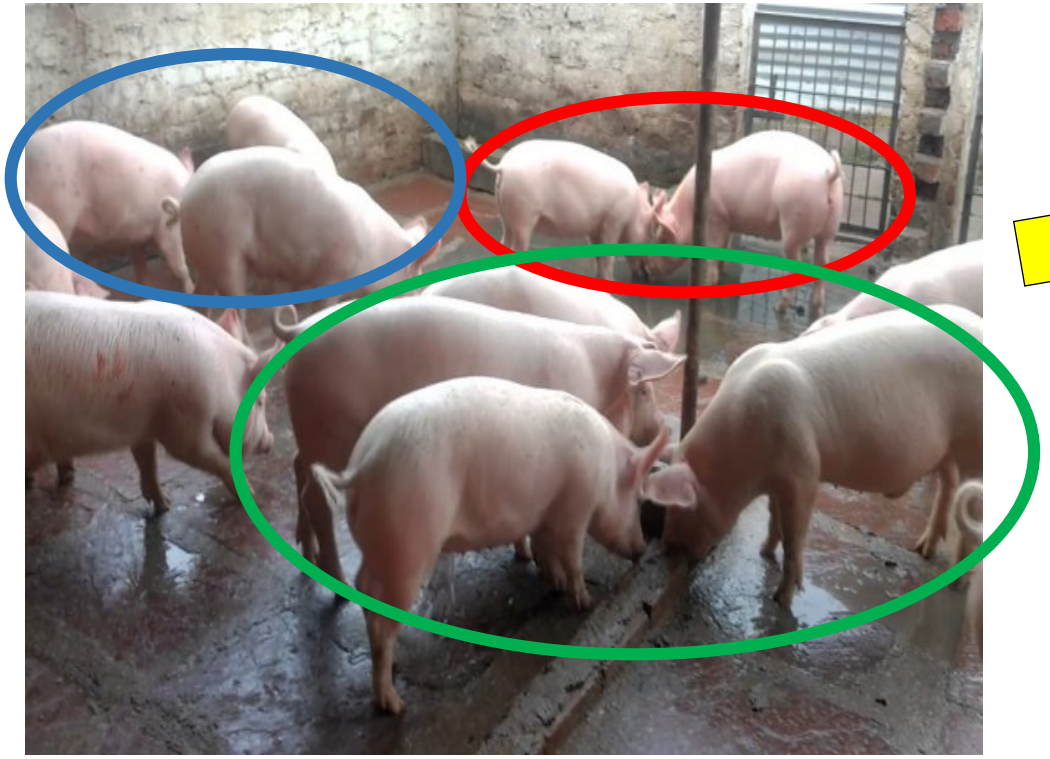
Group of animals that are fully connected

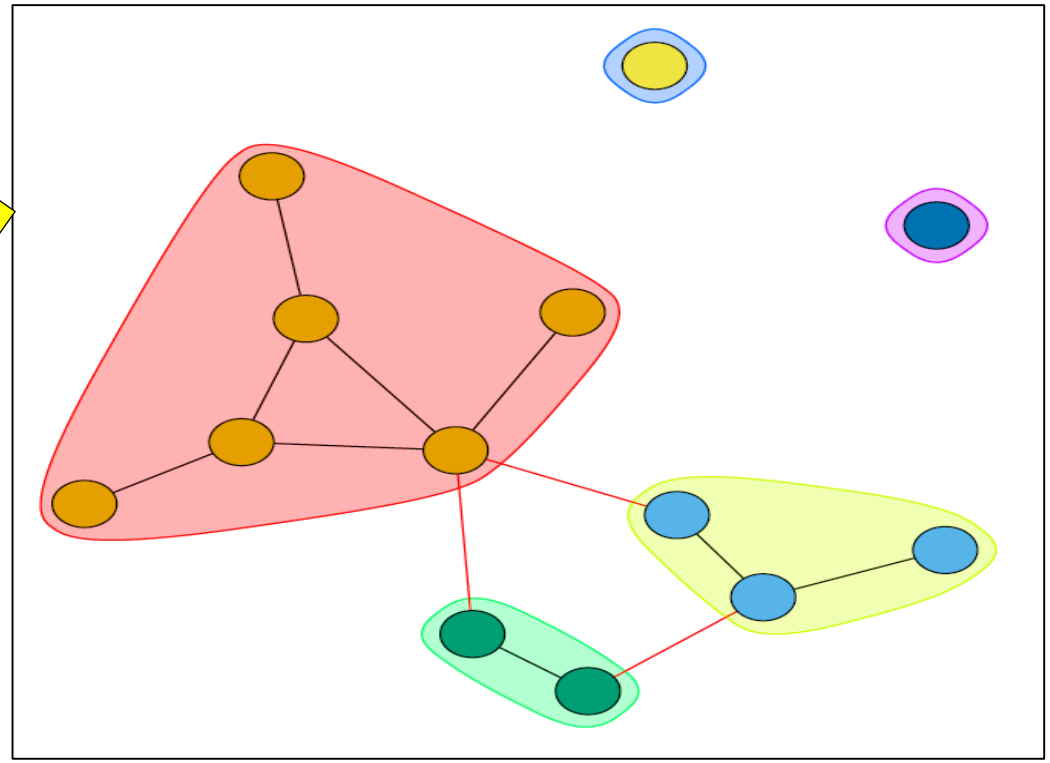


3. Identification of Communities

2- Modularity

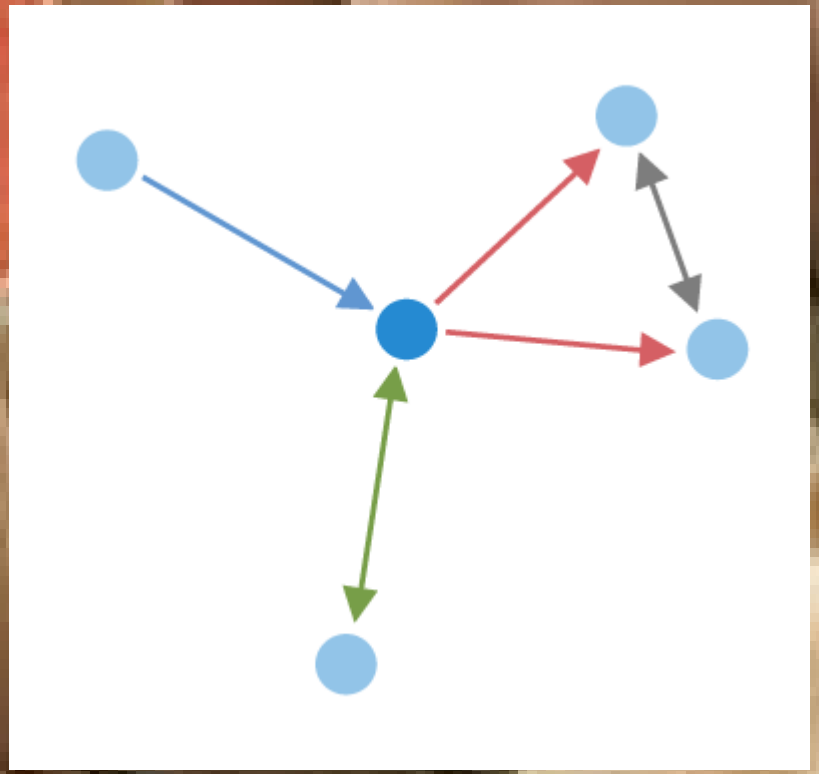
Dividing the group into sub-groups of animals that consistently interact among them more frequently than with others





II. Individual measures

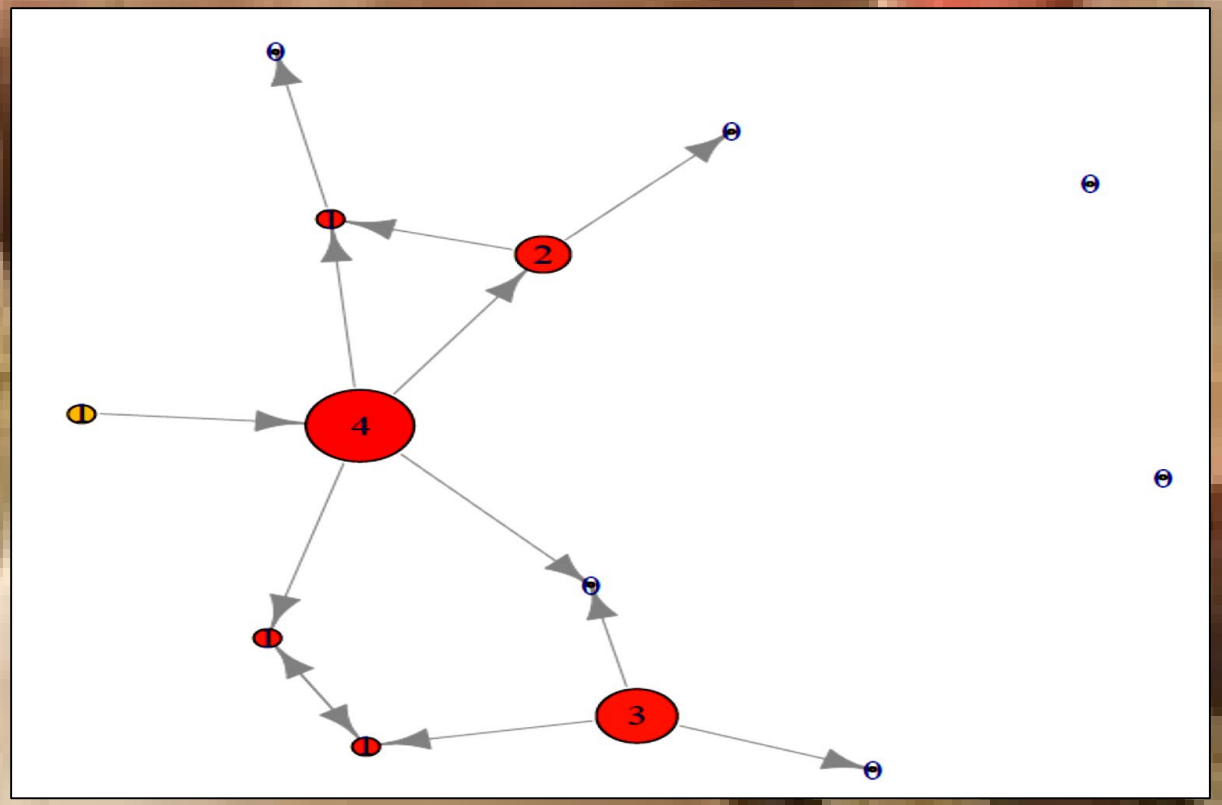
1. Degree = Number of edges linked to a node
   - Out-degree = Edges leaving the node
   - In-degree = Edges reaching the node
   - All-degree = Count of all edges
2. Eigenvector centrality
3. Betweeness centrality
4. Closeness centrality



Out-degree centrality

The number of Edges leaving the node

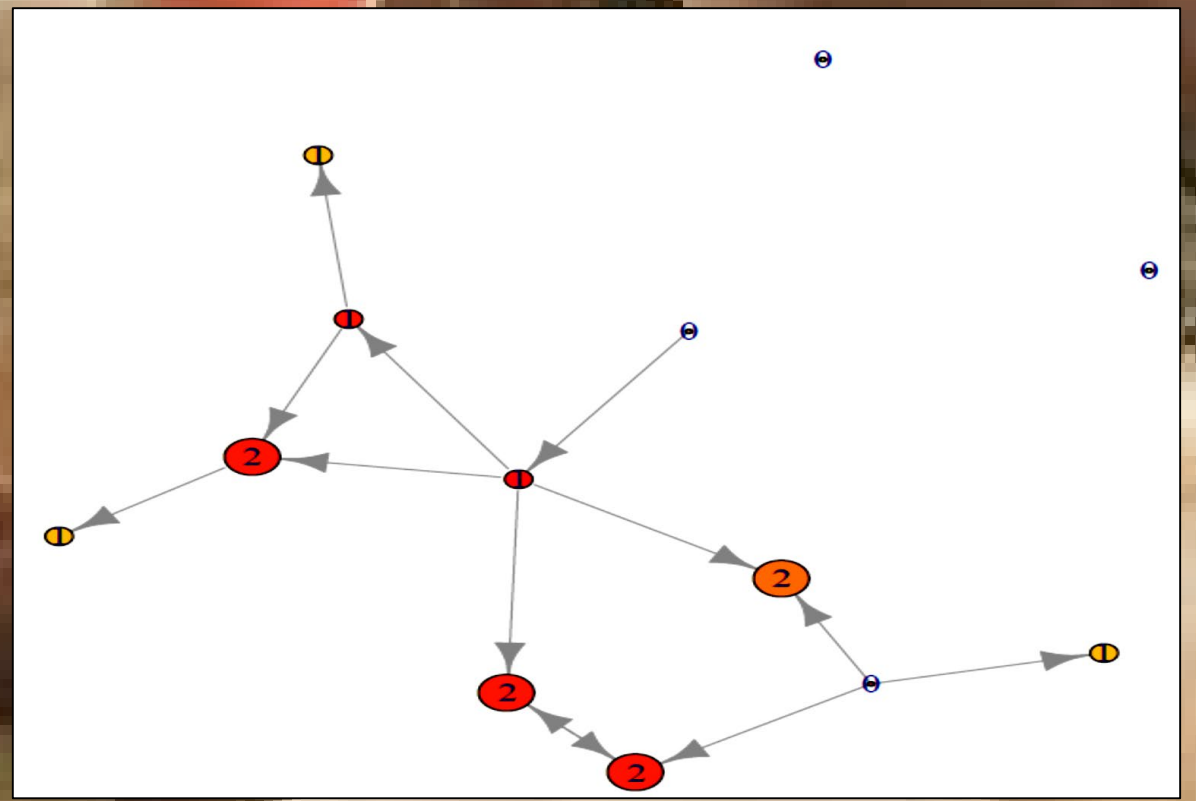
“Initiated Agonistic Behavior”



In-degree centrality

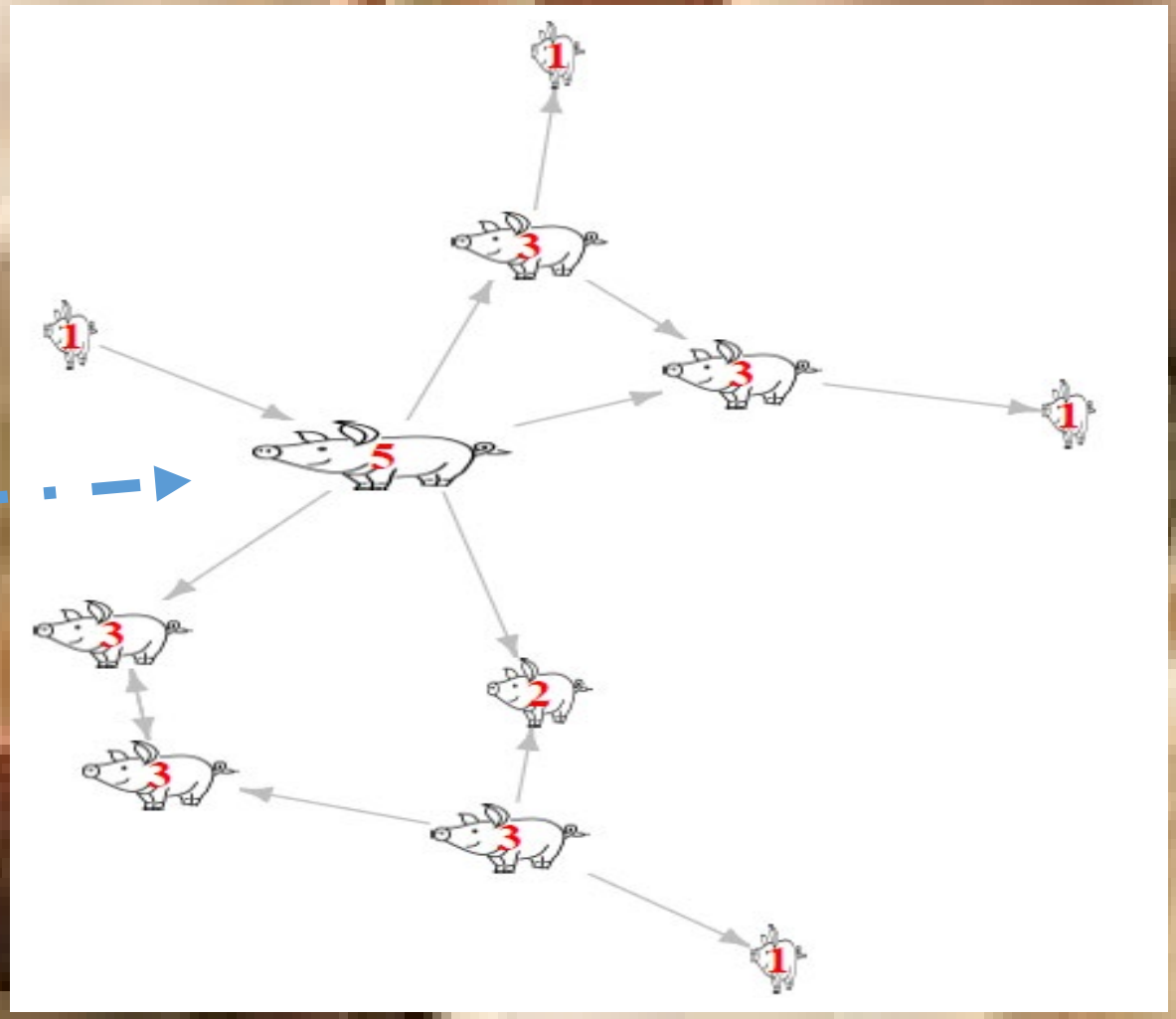
The number of Edges reaching the node

“Received Agonistic Behavior”



All-Degree Centrality

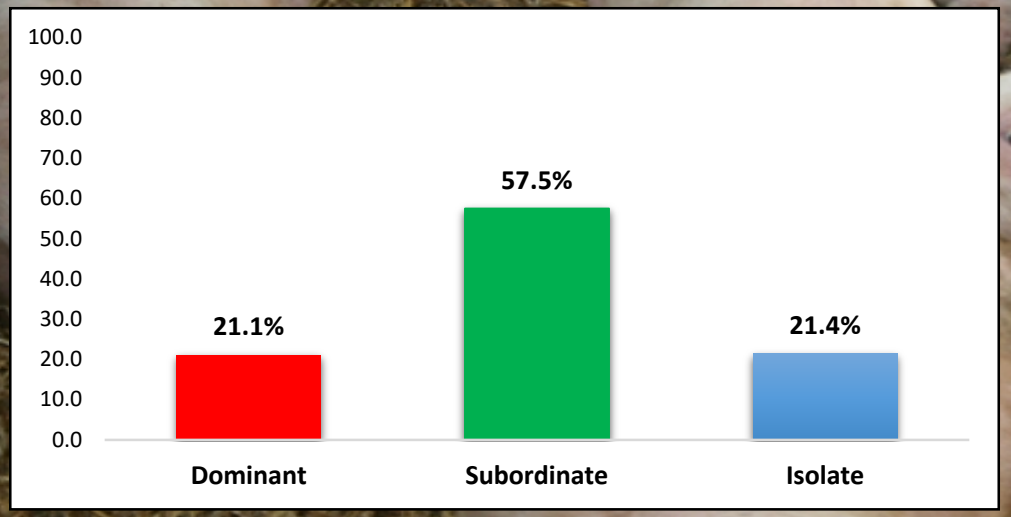
- The number of all edges that a node has.
- The animal with the highest degree is the one more involved in aggression.



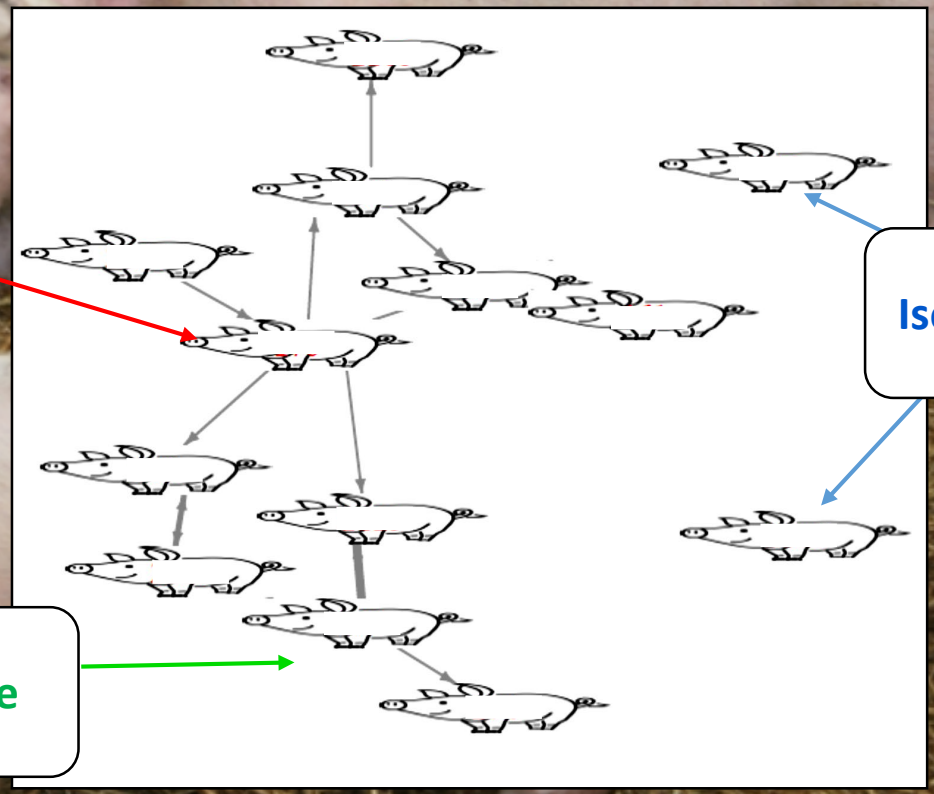
From the degree records, social rank could be defined

Social Rank Index= Out-degree/All-degree

- **Dominant >= 0.7**
- **Subordinate < 0.7**
- **Isolate: zero All-degree**



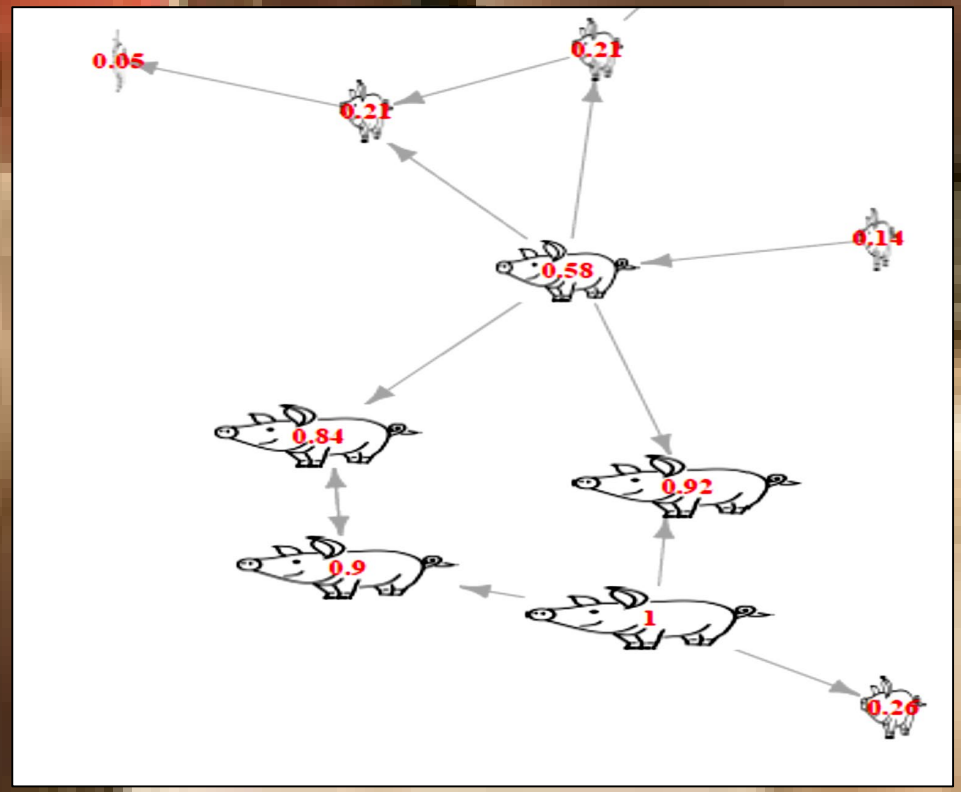
Social Rank Index in Duroc Pigs



Eigenvector centrality

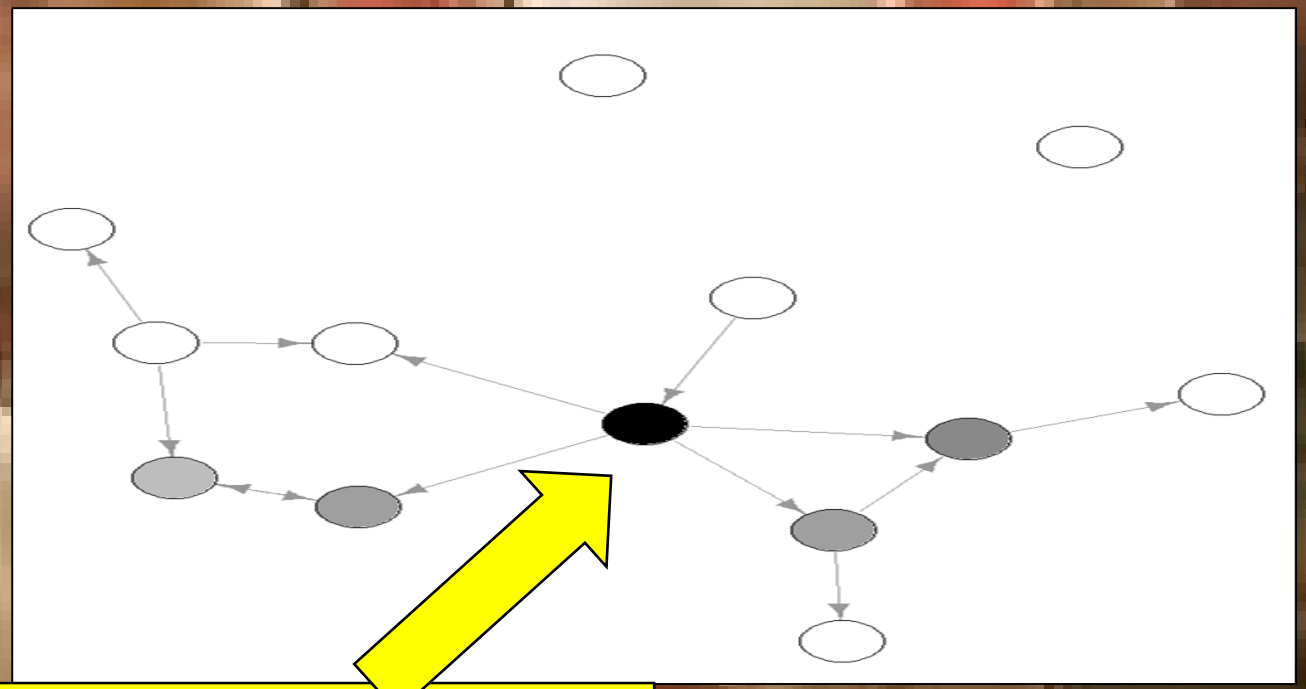
Eigenvector centrality accounts for the **degree** and **importance** of connections.

- Eigenvector coefficient = 0 (least central)
- Eigenvector coefficient = 1 (high influence)



Betweenness centrality

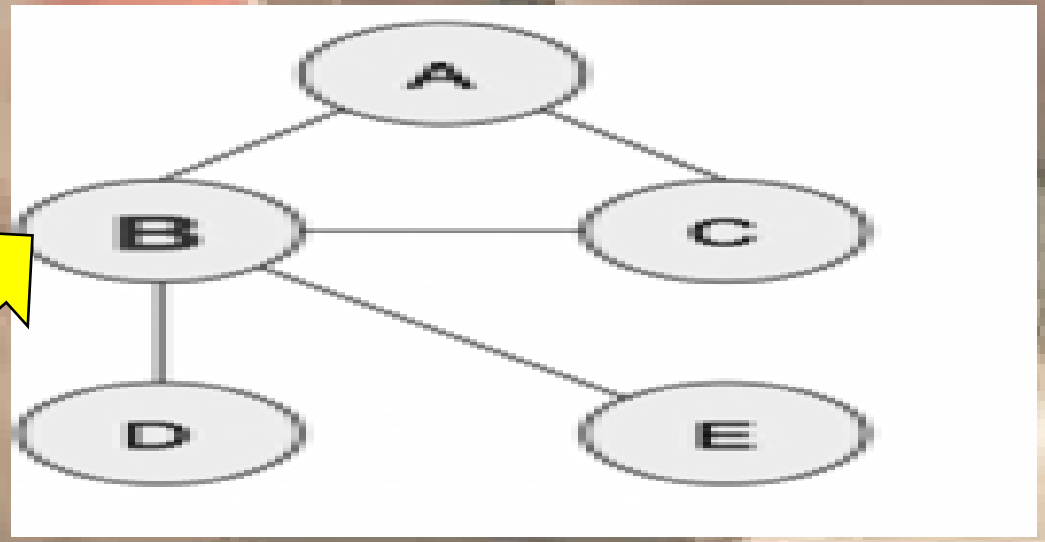
Identifies the animals that play a key role in the transmission of aggression



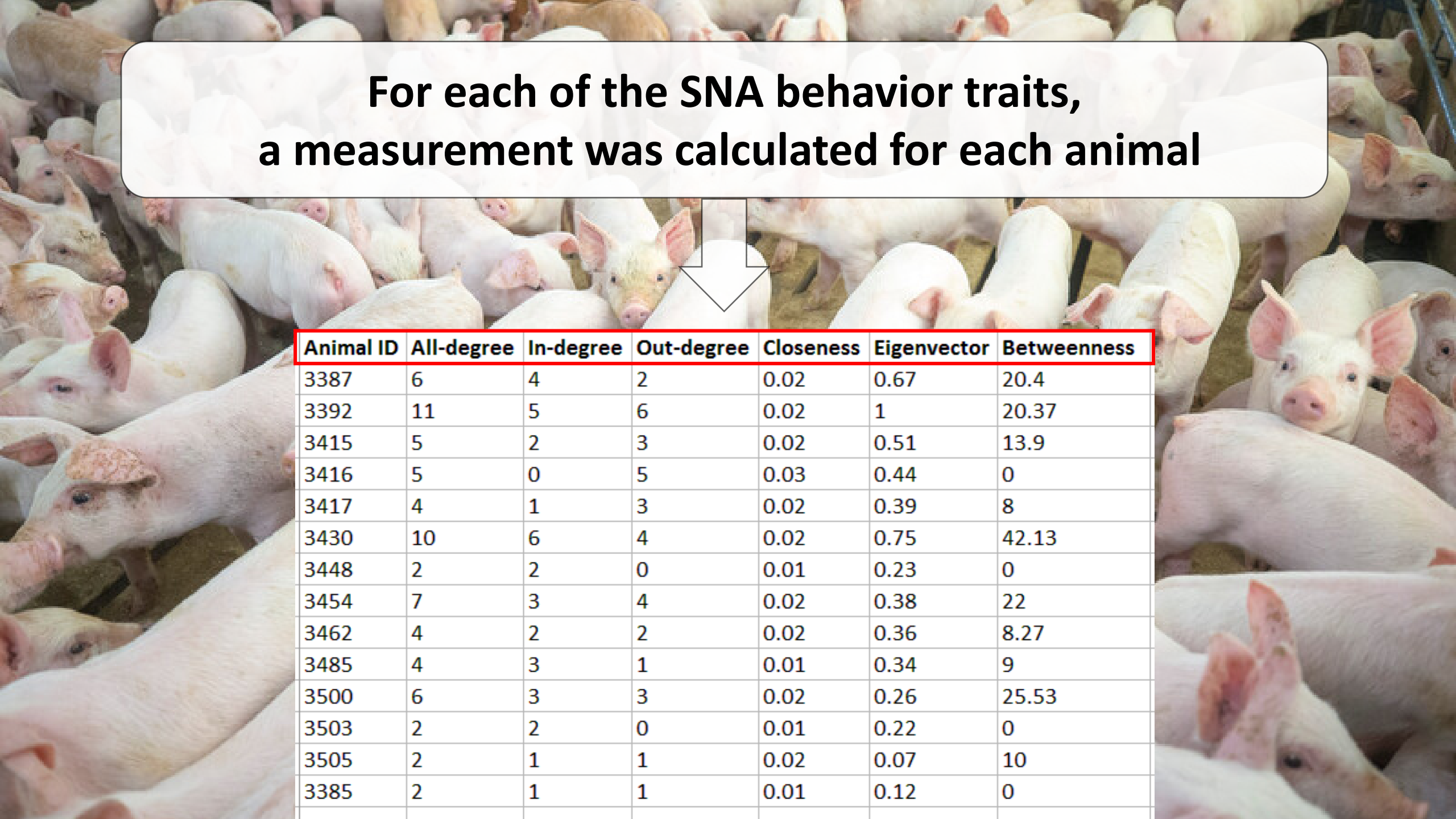
Removal of this animal will break the network & reduce the aggression in the pen

Closeness centrality

Closeness centrality measures how far a node is to all other nodes in the network.



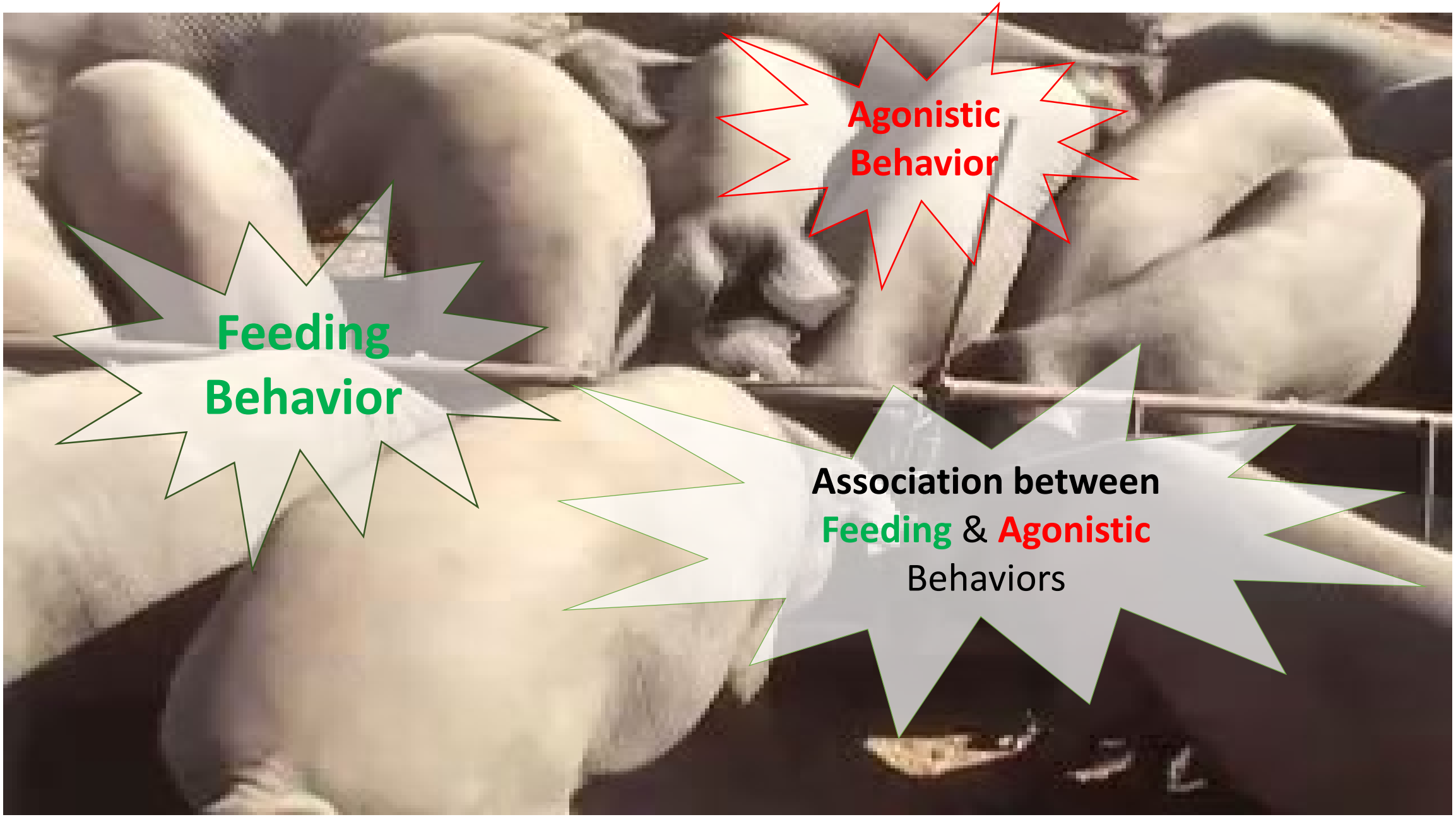
Animal **B** has the highest Closeness,
as it is directly connected to all the animals in the pen



For each of the SNA behavior traits, a measurement was calculated for each animal

Animal ID	All-degree	In-degree	Out-degree	Closeness	Eigenvector	Betweenness
3387	6	4	2	0.02	0.67	20.4
3392	11	5	6	0.02	1	20.37
3415	5	2	3	0.02	0.51	13.9
3416	5	0	5	0.03	0.44	0
3417	4	1	3	0.02	0.39	8
3430	10	6	4	0.02	0.75	42.13
3448	2	2	0	0.01	0.23	0
3454	7	3	4	0.02	0.38	22
3462	4	2	2	0.02	0.36	8.27
3485	4	3	1	0.01	0.34	9
3500	6	3	3	0.02	0.26	25.53
3503	2	2	0	0.01	0.22	0
3505	2	1	1	0.02	0.07	10
3385	2	1	1	0.01	0.12	0


Isolate animal
Subordinate animal
Dominant animal
I am Hungary !!!!
Can I eat with you Guys
I will eat FIRST
Dominant pigs
eat more?
grow more?
more efficient??


Agonistic Behavior
Feeding Behavior
Association between Feeding & Agonistic Behaviors

Correlation between Feeding & Agonistic Behaviors

Feeding Rate (FR)

Average feed intake per unit of time, in g/min.

Feeding Frequency (FF)

Total number of visits to the feeder per day, in units.

Occupation Time (OT)

Time at feeder trough per day, in min/day.

Time between consecutive visits (FInt)

The mean of time between two consecutive visits per day, in min/day.

	FR	OT	FF	FInt
All-degree	-0.18**	0.14*	0.11*	-0.10
In-degree	-0.11*	0.08	0.09*	-0.07
Out-degree	-0.18*	0.15*	0.10	-0.11
Closeness	-0.06	0.20*	0.01	-0.05
Eigenvector	-0.02	0.02	0.08*	-0.02
Betweenness	-0.15*	0.02	0.11*	-0.07

Low correlations between Feeding and Agnostic behavior in the studied Duroc pigs

Correlation between SNA Agonistic behaviour and performance traits

	Backfat	Body weight	ADC	FCR	ADG
All-degree	-0.07	-0.04	0.04	0.17*	-0.07
In-degree	-0.10	-0.08	-0.02	0.09	-0.11
Out-degree	-0.01	0.01	0.07	0.18*	-0.01
Closeness	0.12*	0.09	0.15*	0.17*	0.07
Eigenvector	0.01	-0.04	-0.06	-0.02	-0.07
Betweenness	-0.01	-0.05	-0.02	0.10	-0.08

*p<0.05, ADG = average daily gain; ADC = average daily consumption; FCR = feed conversion ratio.

Low correlations between Agonistic behavior and performance traits in Duroc

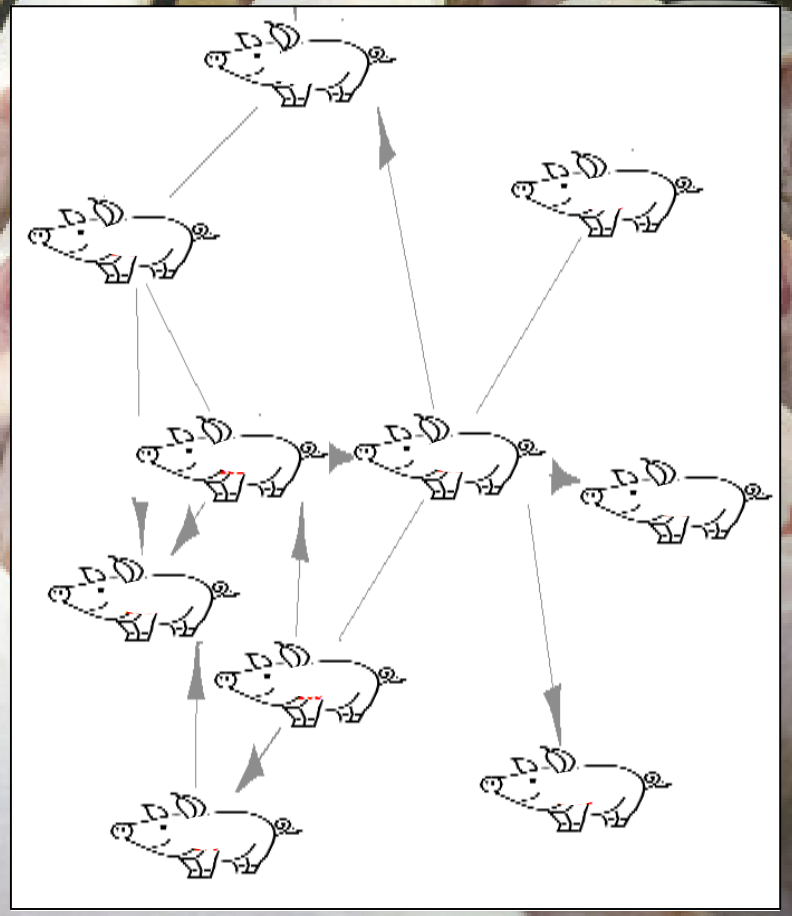
Summary

1. **SNA approach showed the potential in:**

- Describing the social structure of each pen.

- Quantifying the role of each animal in aggression.

2. **SNA behaviour traits had low correlations with feeding behavior and performance in the studied Duroc pigs.**



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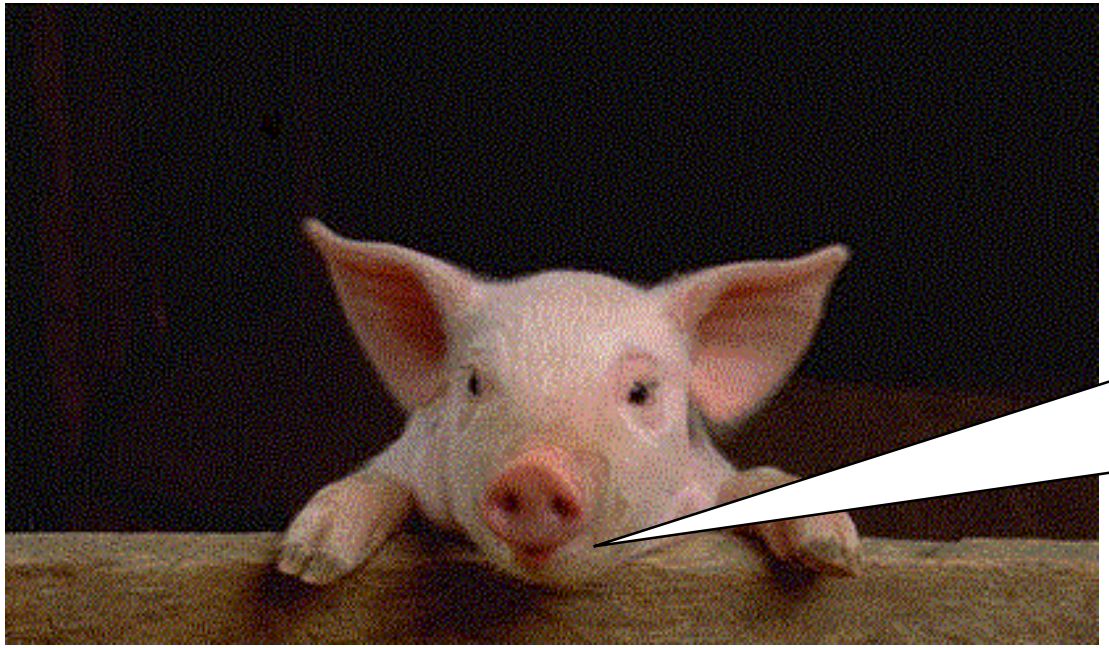

Thanks for your attention