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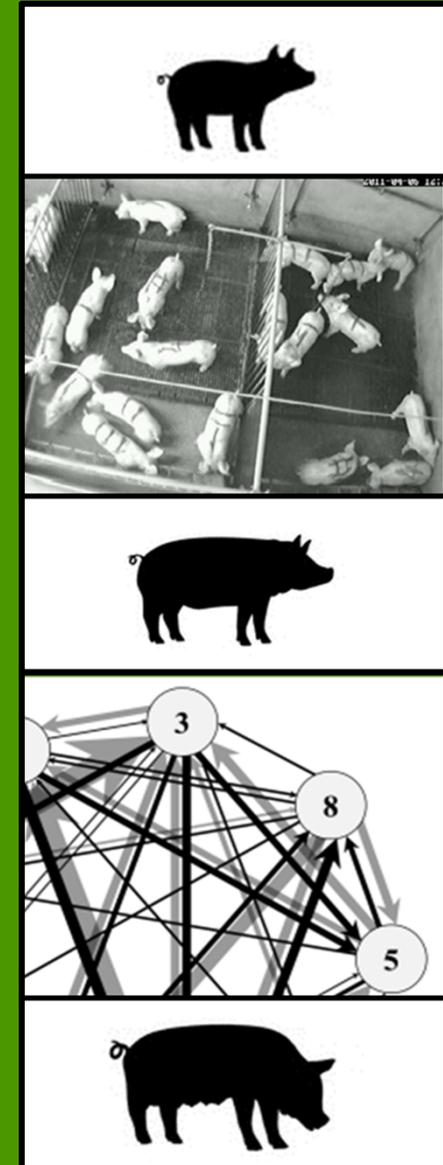
Social network analysis – Investigation of agonistic behaviour in pig production

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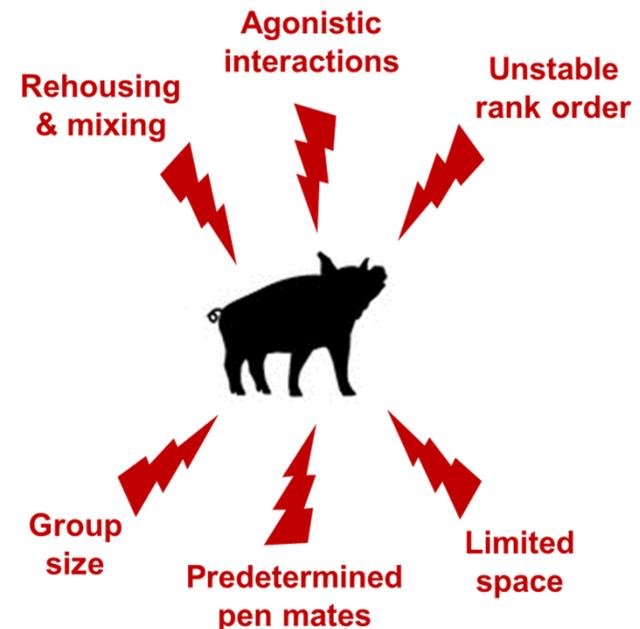
Session 54, abstract number 18641, kbuettner@tierzucht.uni-kiel.de





Introduction

- **Mixing of unacquainted animals** is a standard procedure in commercial pig production
 - Unstable social structures
 - Increased agonistic interactions in order to establish a new rank order
- **Agonistic interactions** negatively influence
 - Animal health
 - Animal welfare
 - Production parameters





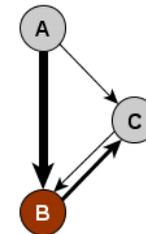
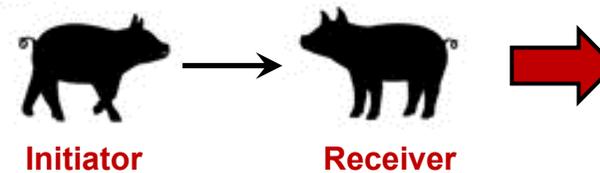
Introduction

- **Network analysis**

- Characterization of the structures of social relationships
- Knowledge about formation and development of behavioural patterns

- **Network view of agonistic interactions**

- Nodes: Individual animals
- Edges: Agonistic interactions





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- Edges: Agonistic interactions



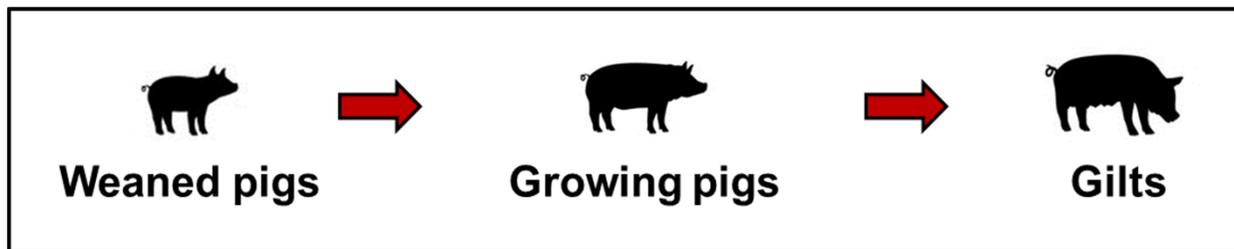
- **Aim of the study**

- Development of the network parameters over three different age levels
- Impact of the network position in previous rehousing and mixing situations?



Video observation

- **Observation period:** December 2010 to August 2012
- **Research farm “Hohenschulen“** (Institute of Animal Breeding and Husbandry, Christian-Albrechts-University, Kiel)
- Record of **agonistic interactions** of pigs in three different age levels



- The video observation started **directly after rehousing and mixing** for two days
 - **7,020 agonistic interactions** between **1,354 animals**
 - **149 animals** were tracked the whole period from weaned pig to gilt



Agonistic interactions

- **Definition of an agonistic interaction**

- **Start:** **Physical contact** of one animal towards another (> 1 sec)

Examples: Head to head knocks, head to body knocks,
parallel or inverse pressings, biting

- **End:** **Submissive behaviour** of an involved animal

Examples: Turning away, displacement from a location, fleeing



Head to head knock



Head to body knock



Social network analysis

- **Centrality parameters**
 - Node level
 - Description of the individuals' position in the network
 - “Which are the most central or important nodes in the network?”
- **General network properties**
 - Network level
 - Description of the whole network structure
 - Comparison between different networks



Social network analysis

Centrality parameters

- **Degree centrality**

- Unweighted: Number of opponents

- Weighted: Number of fights

- **In-degree centrality**

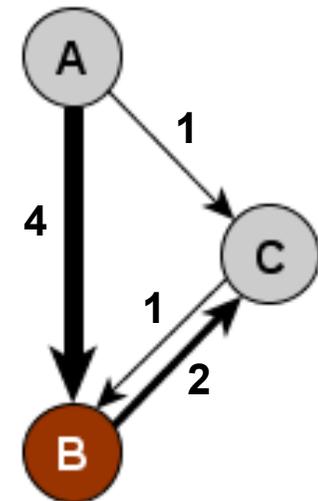
- Unweighted: Number of attackers

- Weighted: Number of received fights

- **Out-degree centrality**

- Unweighted: Number of attacked opponents

- Weighted: Number of initiated fights

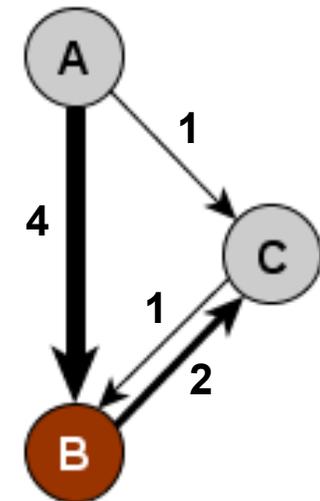




Social network analysis

Centrality parameters

• Degree centrality	Animal B
→ <u>Unweighted</u> : Number of opponents	2
→ <u>Weighted</u> : Number of fights	7
• In-degree centrality	
→ <u>Unweighted</u> : Number of attackers	2
→ <u>Weighted</u> : Number of received fights	5
• Out-degree centrality	
→ <u>Unweighted</u> : Number of attacked opponents	1
→ <u>Weighted</u> : Number of initiated fights	2





Social network analysis

General network properties

- **Density**

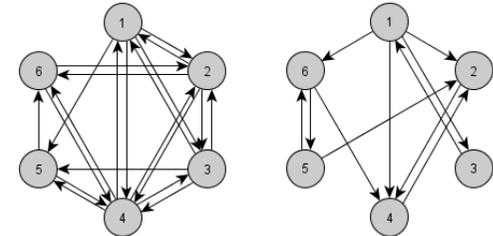
→ Proportion of all present edges in comparison to the number of all possible edges (Range: 0 to 1)

- **Clustering coefficient**

→ Extent two opponents of an animal are opponents themselves (Range: 0 to 1)

- **Degree assortativity**

→ The tendency of an animal to fight preferably with other animals which have a similar degree compared to their own (Range: -1 to 1)





Centrality parameters

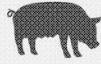
Median number (range) of animals and fights in each age level

	Weaned pigs 	Growing pigs 	Gilts 
Animals / Pen	9 (6 - 11)	23 (20 - 25)	24 (18 - 29)
Fights / Pen	52 (18 - 280)	80 (44 - 120)	68 (38 - 118)
<u>Degree</u>			
Opponents / Animal (unweighted)	7 (0 - 16)	5 (1 - 18)	5 (0 - 22)
Fights / Animal (weighted)	12 (0 - 96)	5 (1 - 27)	5 (0 - 36)
<u>In-degree</u>			
Attackers / Animal (unweighted)	4 (0 - 8)	3 (0 - 11)	3 (0 - 11)
Received fights / Animal (weighted)	7 (0 - 51)	3 (0 - 16)	3 (0 - 17)
<u>Out-degree</u>			
Victims / Animal (unweighted)	3 (0 - 9)	2 (0 - 10)	2 (0 - 16)
Initiated fights / Animal (weighted)	5 (0 - 73)	3 (0 - 17)	2 (0 - 29)



Centrality parameters

Spearman rank correlation coefficients between in-degree and out-degree in three different age levels

	Weaned pigs 	Growing pigs 	Gilts 
In-degree – out-degree	0.70*	0.48*	0.61*

* $p < 0.05$

Spearman rank correlations of the centrality parameters between the age levels

	Weaned pigs - growing pigs  → 	Growing pigs - gilts  → 
Degree	0.19*	0.19*
In-degree	-0.02	0.07
Out-degree	0.27*	0.25*

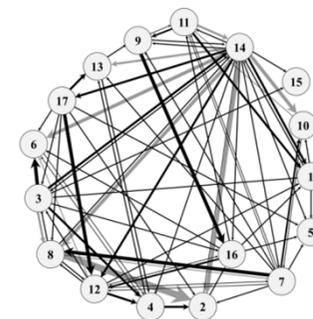
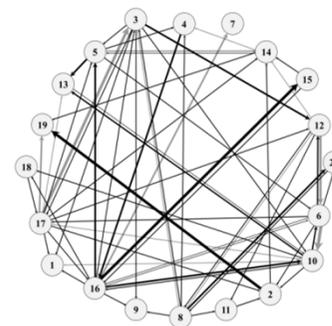
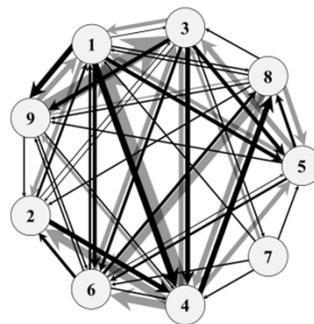
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General network properties

Median number (range) of the general network properties density, clustering coefficient and degree assortativity in each age level

	Weaned pigs 	Growing pigs 	Gilts 
Density	0.45 (0.24 - 0.94)	0.13 (0.07 - 0.17)	0.12 (0.06 - 0.25)
Clustering coefficient	0.75 (0.29 - 1)	0.32 (0.14 - 0.50)	0.22 (0.05 - 0.56)
Degree assortativity	-0.25 (-0.78 - 0.15)	-0.10 (-0.37 - 0.24)	-0.19 (-0.34 - 0.14)





Centrality parameters

- **Decrease of agonistic interactions with higher age level**
 - Habituation effect
 - Development of new coping strategies
- **Lower correlation coefficients between in-degree and out-degree in growing pigs and gilts**
 - More stable network position due to their increased familiarity and their experiences acquired from previous agonistic interactions
- **Correlations between the out-degree over the three different age levels showed more stable results**
 - Out-degree describes an active behaviour
 - In-degree depends on the aggression of the pen mates



General network properties

- **Decrease of density and clustering coefficient in older age levels**
 - Learning process from previous fighting situations
 - Gained confidence acquired by previous success
- **Negative degree assortativity in all three age levels**
 - Networks with a negative connotation show a smaller reciprocity than networks with a positive connotation (e.g. grooming, affiliation)



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- **Network analysis**
 - Characterization of individual position in agonistic interaction networks
 - Development of network parameters over different age levels
 - New insights in the formation and evolution of behavioural patterns



Thank you for your attention!

