Stiftung Tierärztliche Hochschule Hannover
University of Veterinary Medicine Hannover, Foundation

Social hierarchy formation
when piglets are mixed in different group compositions after weaning

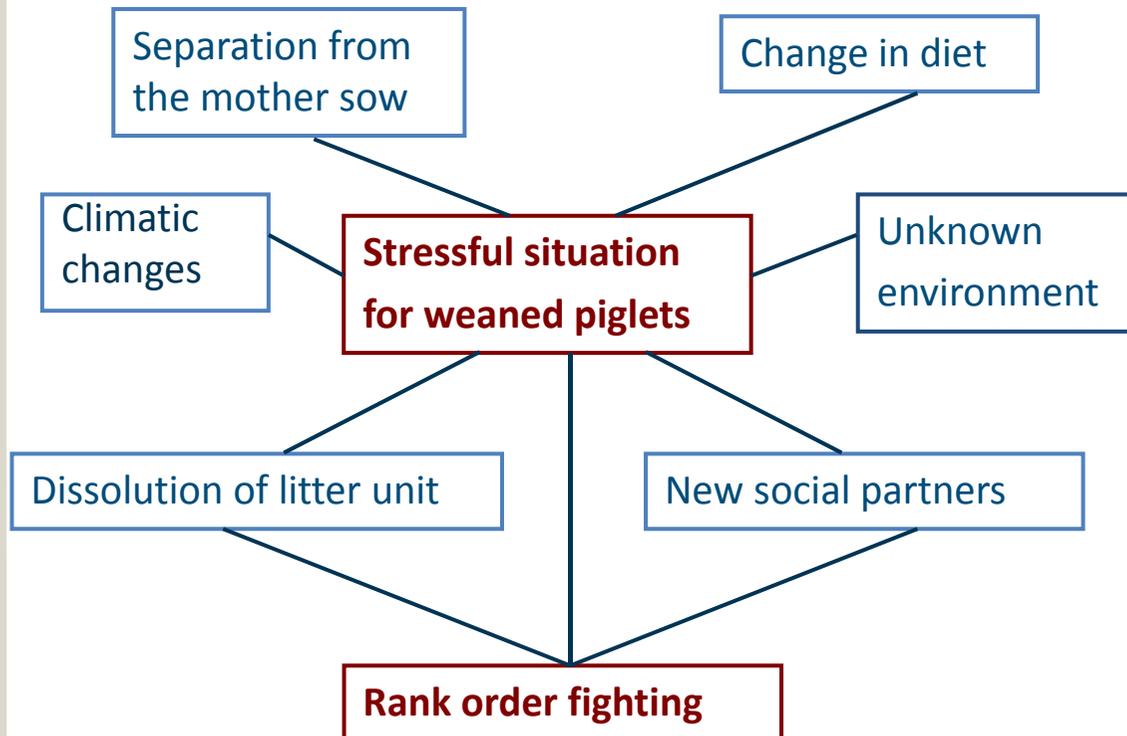*Michaela Fels[1], Nicole Kemper[1], Steffen Hoy[2]*

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Mixing piglets after weaning, sorting by weight and sex
= common management practice

Separation from the mother sow

Change in diet

Climatic changes

Stressful situation for weaned piglets

Unknown environment

Dissolution of litter unit

New social partners

Rank order fighting

(Meese and Ewbank, 1973; Petherick and Blackshaw, 1987; Ekkel et al., 1995)

Rank order fighting

➡ Establishment of social hierarchy (72 h)

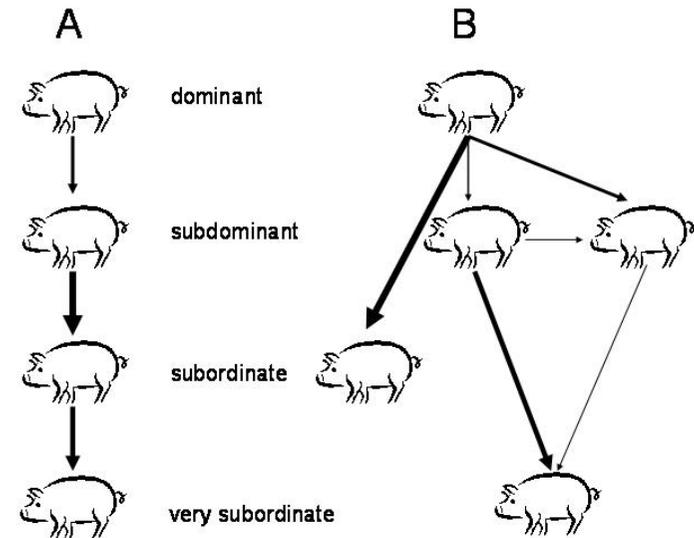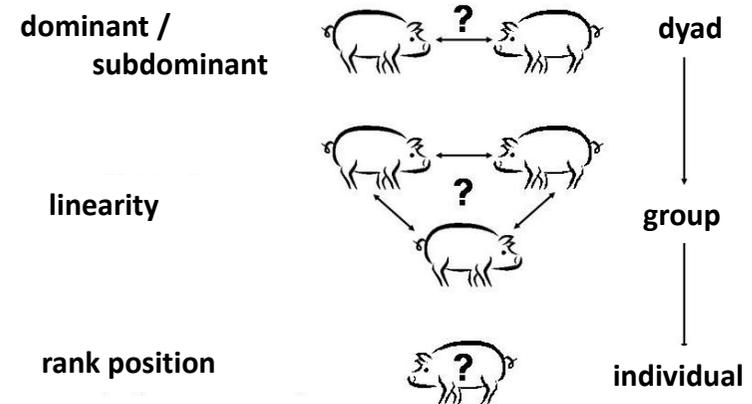➡ Prevention of further fighting

Social structure

= result of all dominance relationships

of all possible pairs of individuals

Social hierarchy:

- linear (dominant to subdominant)
- complex (circular triads)

(Fels, 2008; Fels and Hoy, 2008; Puppe et al., 2008;

Langbein and Puppe, 2004; Chase et al. 2002)

Study design

Objective: **Are social hierarchy formation and aggression after weaning and mixing affected by group composition?**

Place: Research farm of Justus Liebig University Giessen, Germany

Animals: Piglets of different breeds
(Weaning: every 3 weeks, age 28 days, mean initial weight 7.8 kg)

Housing: Weaner pens with partially slatted floor,
0.4 m² per animal, 12 piglets per pen
animal-feeding place ratio 1.5:1
(dry feed, ad libitum),
1 nipple drinker per pen

Study design

Day before weaning: Weighing and sexing of all suckling piglets

Weaning day: **Mixing piglets into groups of 12 (6)**

Different group compositions:

- **Homogeneous and heterogeneous weight groups**

- **Single sex groups**

- **Groups with 6 piglets from 2 litters each and**

  groups with 2 piglets from 6 litters each

 - **Different group sizes (6 and 12)**

   (n = 38 groups, 5 rearing batches)

homogeneus weight groups with equal sex ratio

Continuous video-recording (72 h after weaning)

Study design

Aggressive interactions

= fights or displacements with physical contact initiated by one individual including aggressive behaviour elements (head knocking, biting) followed by any form of submission performed by the opponent (Langbein and Puppe, 2004).

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Analysis of dyadic relationships

- Number and outcome of all agonistic interactions (72 h)

- Winner-loser matrix

Calculation of:

Sociometric Parameters (MatMan 1.1; Noldus):

- **one-way relationships**
(dyads with wins only for one individual)

- **two-way relationships**
 (dyads with wins for both individuals)

 - **tied relationships**
(the same number of wins for both individuals)

- **unknown relationships**
(dyads without any observed interaction)

Piglet	Loser											
	1	2	3	4	5	6	7	8	9	10	11	12
1		III										
2				II								
3	I											
4												
5			°									
6												
7												
8												
9												
10												
11												
12												

(Winner — row axis label)

- **Calculation of Sociometric Parameters on group level** (MatMan 1.1, Noldus):

- Linearity indices (h, h´, K)
- Directional consistency index (DCI)

= **Indices indicating the degree of linearity of social hierarchy**

- Can range from 0 (non-linear) to 1 (absolutely linear)

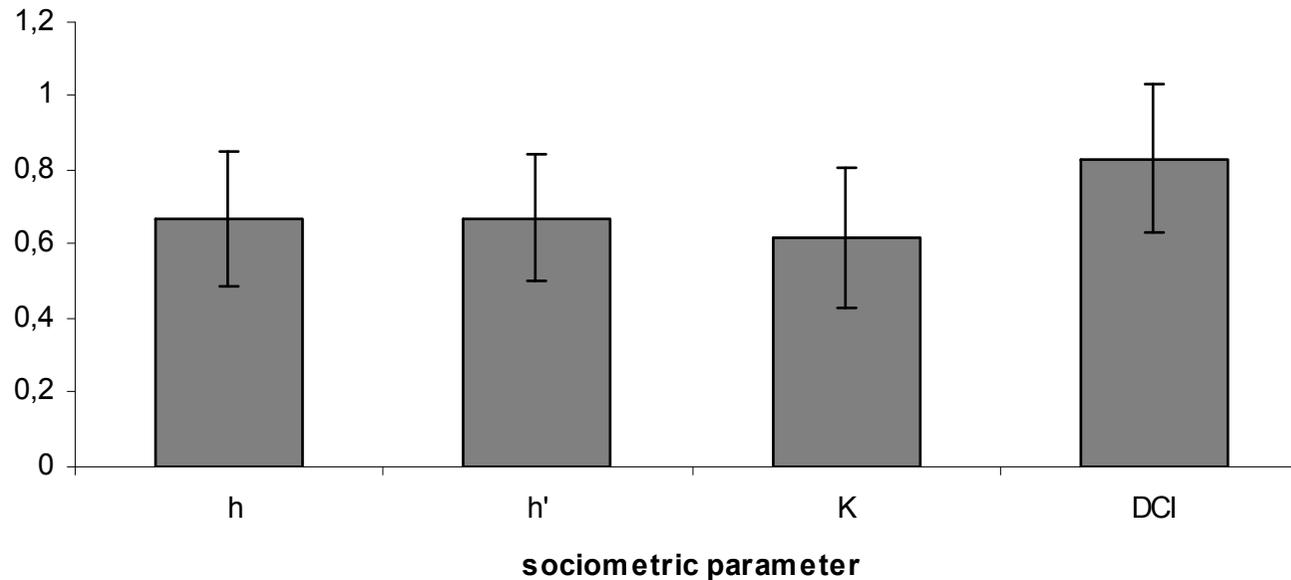$$h = \frac{12}{n^3 - n} \ (S_i - \tfrac{1}{2}(N-1))^2$$

n = group size

S = number of individuals domianted by individual i

Mean values and standard deviations of different sociometric parameters indicating the degree of linearity of social hierarchy across all group compositions (n = 38 groups); $p > 0.05$

➡ **Piglets developed quasi-linear hierarchies, independent of group composition**

Results: Sociometric parameters on group level

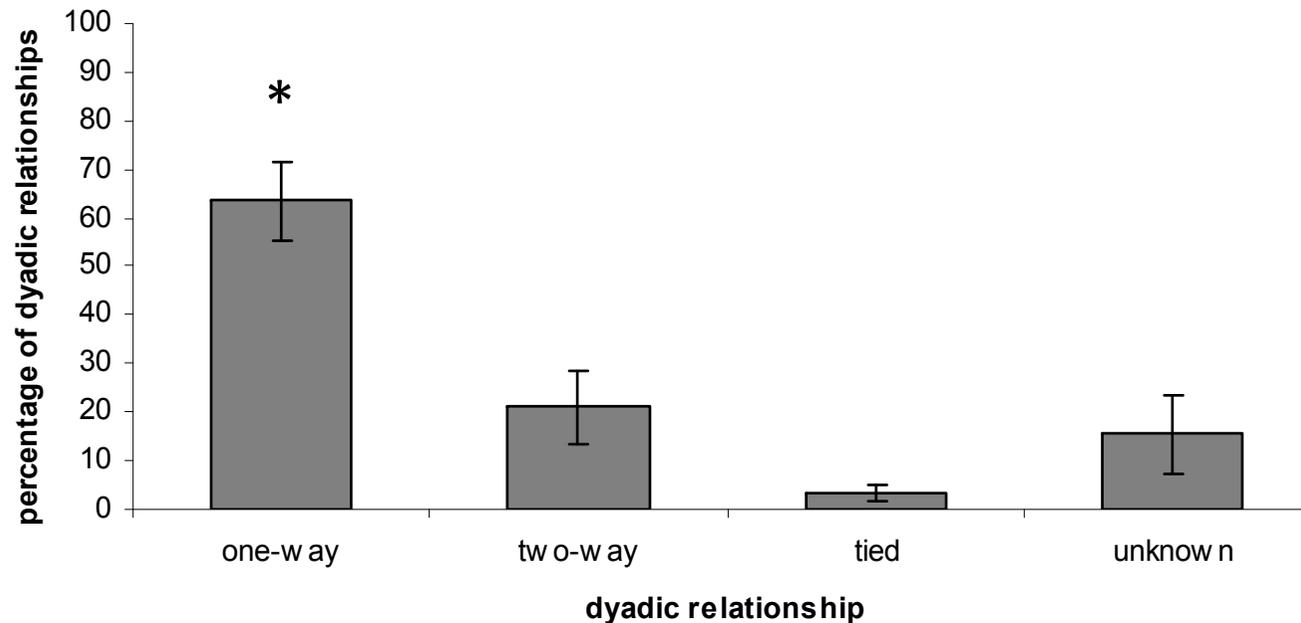| group composition	n (groups)	h	h´	K	DCI
homogeneous	6	0.63 (± 0.11)	0.66 (± 0.11)	0.62 (± 0.11)	0.78 (± 0.11)
heterogeneous	5	0.57 (± 0.17)	0.61 (± 0.16)	0.56 (± 0.17)	0.85 (± 0.05)
6 piglets from 2 litters each	5	0.50 (± 0.11)	0.57 (± 0.09)	0.49 (± 0.11)	0.79 (± 0.70)
2 piglets from 6 litters each	5	0.63 (± 0.19)	0.67 (± 0.17)	0.63 (± 0.19)	0.83 (± 0.05)
male	4	0.63 (± 0.09)	0.67 (± 0.08)	0.63 (± 0.09)	0.84 (± 0.06)
female	4	0.59 (± 0.22)	0.64 (± 0.18)	0.58 (± 0.22)	0.87 (± 0.17)
groups of 6 piglets	6	0.89 (± 0.17) **a**	0.9 (± 0.17) **a**	0.88 (± 0.19) **a**	0.91 (± 0.34)
groups of 12 piglets	3	0.50 (± 0) **b**	0.54 (± 0.02) **b**	0.49 (± 0) **b**	0.78 (± 0.08)

Different letters indicate significant differences.

➡ **Mean values of sociometric parameters were significantly higher in groups of 6 piglets than in groups of 12 piglets**

Mean values and standard deviations of different sociometric parameters indicating the type of dyadic relationships across all group compositions (n = 38 groups), * = p < 0.05

➡️ **For all groups, most of dyadic relationships were one-way relationships (dyads with wins only for one individual)**

Results: Aggressive interactions

Number of fights per piglet during 72 h after mixing in different group compositions
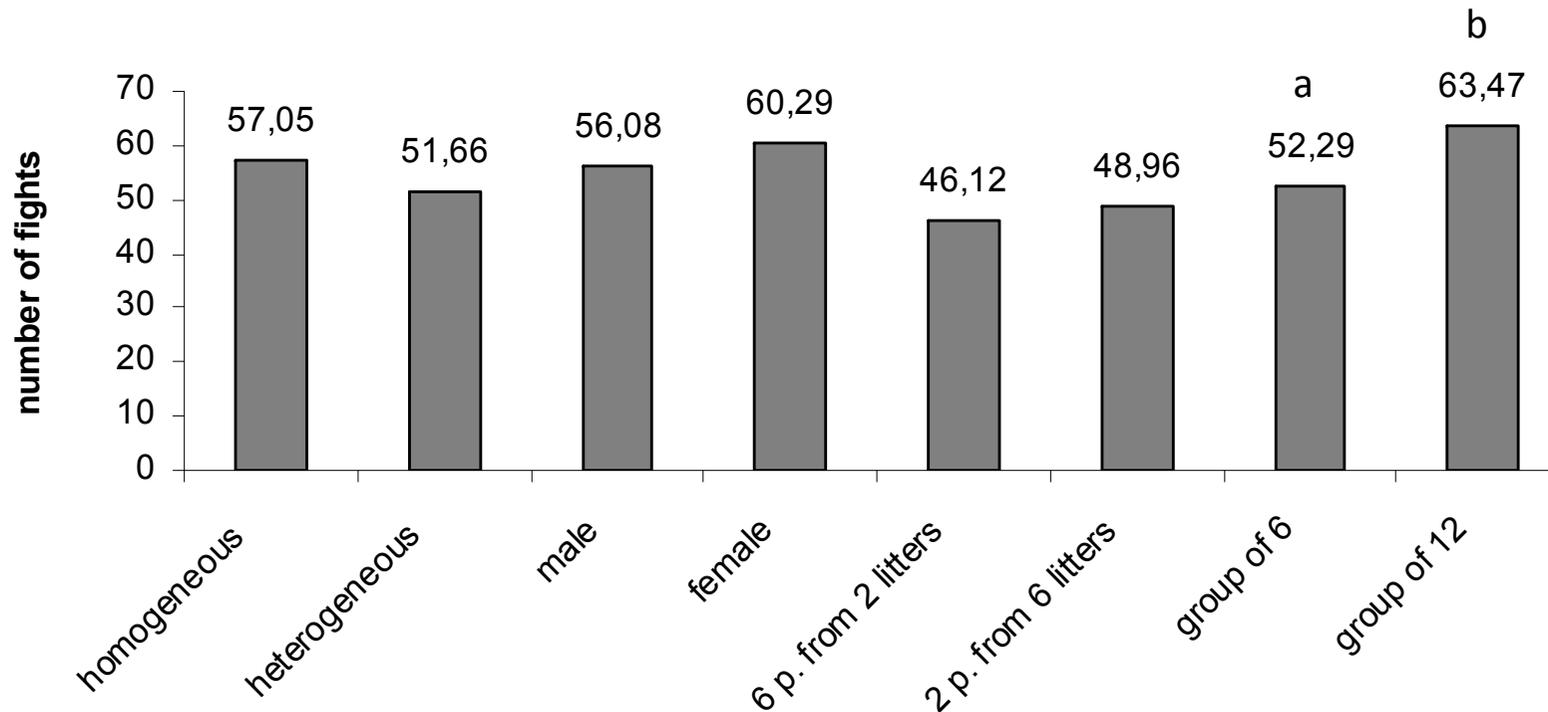
Different letters indicate significant differences.

➡ **In groups of 6 piglets, individuals fought significantly less than in groups of 12 piglets**

Conclusions

Piglets are motivated to form a linear hierarchy after mixing, regardless of group composition

⇒ **Piglets in groups of 6 established almost totally linear hierarchies indicated by h' = 0.09**

⇒ **When increasing group size, the degree of linearity decreases (h' = 0.54 in groups of 12)**

⇒ **Group composition (weight variation, number of littermates, single sex groups) showed no further effect on the linearity of social structure and the number of aggressive interactions**

A

dominant

subdominant

subordinate

very subordinate

Conclusions
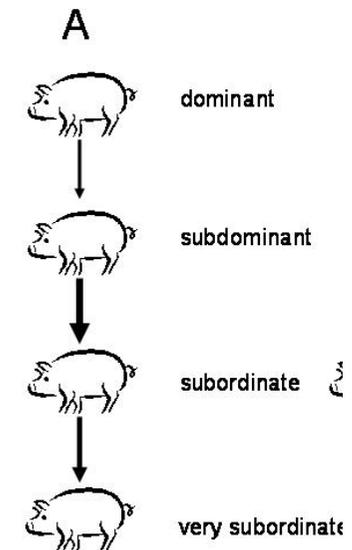
The social structure results from all dominance relationships of all possible pairs of individuals within a group.

$\Rightarrow$ **No significant differences between the percentages of dyadic relationships of different group compositions were found.**

$\Rightarrow$ **For all groups, there was a majority of one-way relationships. Within a dyad, mostly the same piglet won a fight and was dominant.**

$\Rightarrow$ **In 10 – 15 % of cases, no fight was observed between two individuals. (Rank position clarified by threats and defensive behaviour?)**

In most cases, relationships between pairs of individuals within a dyad were clearly established.

Indices

- $$h = \frac{12}{n^3 - n} \sum_{i=1}^{n} (S_i - \frac{1}{2}(n-1))^2$$

  N = group size

  Si = number of individuals dominated by individual i

  D = number of circular triads

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- $$h' = h + \frac{6}{n^3 - n}$$

- $$K = 1 - \frac{24d}{n^3 - n} \quad \text{or} \quad = 1 - \frac{24d}{n^3 - 4n}$$

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- (if n uneven)

- $$DCI = \frac{(H - L)}{(H + L)}$$