Synchronisation and clustering of fattening pigs in a needs-adequate facility

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Abstract
In an exploratory study, synchronisation and clustering of pigs was studied by assessing resting and eating behaviour. The data originate from frequent images of pigs in a needs adequate fattening facility. The results confirm the well known synchronisation of overall activity and of resting. However, the synchronisation of eating behaviour turned out to be very limited. Most pigs ate on their own, despite the ample opportunities for social meals. The pigs clustered (reduced their mutual distances) both in lying and (to a lesser extend) in eating behaviour.

Introduction

Comfort Class: meeting the needs of animals
Inspired by the ongoing animal welfare debate, the Comfort Class husbandry concept was introduced. Its central idea is the reasoning that suffering from inadequate housing conditions is the major infringement to animal welfare, and that meeting the needs of animals eliminates this suffering. Ergo, husbandry systems that are designed on meeting the needs of animals can bear the label 'animal friendly'. This (rather utilistic) concept has been adopted by a consortium, jointly led by the major Dutch farmers organisation and the major Dutch animal welfare organisation. The concept has been worked out into a husbandry system for growing/fattening pigs and is currently being investigated. Among other activities, the animal science principles are now being tested in a facility especially built for that purpose by the consortium. In this facility, behaviour, health and facility use of batches of pigs are studied to test the ' welfare' –claim and to assess opportunities for practical improvements (e.g. opportunities for reduction of space allowance).

Intermediate, preliminary report on synchronisation and clustering of pigs
Present "EAAP2007 free communications contribution" reports on the first batch of pigs studied in that "Pigs in ComfortClass'- facility. It is based on BSc-work and should be regarded as an intermediate report. Its aim is to present some first results and to communicate to colleagues that the needs based Comfort Class approach is being worked on. This study focuses on a small part: the degree to which pigs synchronise their activity and on the degree to which they perform activities clustered (thus minimising mutual distances). The requirement for facilities (number of feeders and drinkers, resting space etc.) is determined by the degree of synchronisation in using these facilities. A higher degree of synchronicity results in a larger amount of the resource being required at a time. Conversely, the habit to cluster, to perform a behaviour with decreased mutual distance, generally reduces the required space for the behaviours involved. Results and thoughts on synchronisation and clustering of pigs of work like this can aid in calculating or modelling space requirements for groups of pigs. Present study aims to bring forward some observations related to this. The analysis is predominantly based on simple presentation and visual comparison of frequency distributions and scatter/line plots. During conduction of the work, the required statistical techniques turned out to be quite complicated, and were not feasible within the time frame.

The experiment
In a newly built naturally ventilated pig house, 3 units of each 4 pens were created.
Each pen ($29m^2$) was composed of a covered nest, a slatted floor and a concrete solid floor in between with respective area shares of 25, 25 and 50%. See figure A & B.

In one unit, the four pens were kept separate, and each populated with 12 pigs per pen (treatment 12PPP, 4 repetitions). In the second unit, two sets of two pens were coupled, resulting in two groups of 24 pigs each (treatment 24PPP, 2 repetitions). In the third unit, all four pens were combined, resulting in one group of 48 pigs (treatment 48PPP). The space allowance was based on theoretical calculations for meeting the needs of fattening pigs up to 110 kg live weight. To allow for overlap of activity related space requirements, the coupled pens (excluding the nest boxes) were reduced in size. The resulting stocking densities were 2.4, 2.2 and 2.1 m^2/pig for the treatments 12PPP, 24PPPP and 48PPP, respectively. The pigs were introduced into the facility at an average body weight of 31 kg. They were fed ad libitum al through the experiment, with 6 adjacent feeder places per 12 pigs. Some straw was provided in the nest boxes.

Observations

On four Sundays, in experimental week 3, 6, 9 and 12, a picture was taken from a camera above each pen at every 15 minutes, during 24 hours (96 pictures per pen per observation day, a total of 4 days * 12 pens * 96 = 4608 images). At low light intensities, the colour camera's automatically switched to black and white, clearly visible on the image. The difference between 'light' and 'dark' was based on this criterion.

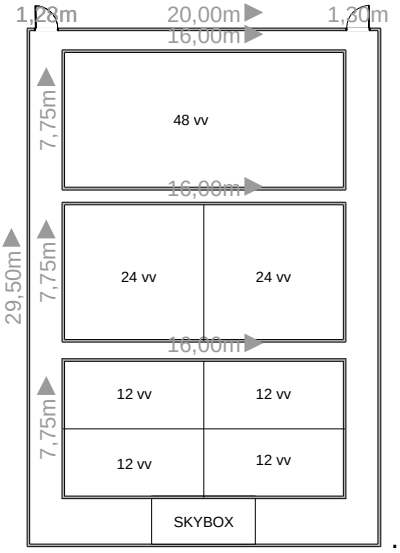

Figure A. Stable layout, potentially 3 blocks of each 4 pens (here combined into 4+2+1 pens)

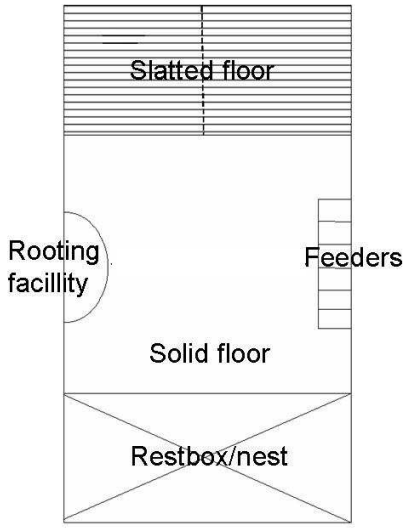

Figure B. Pen layout (29m2 for 12 pigs)

Conditions

Observation date		dark>light	light > dark	T_{min} (°C)	T_{max} (°C)
Week 3	23-04-2006	6:15 - 6:30	20:45 - 21:00	7,5	14.5
Week 6	14-05-2006	5:30 - 5:45	21:30 - 21:45	6,7	17.0
Week 9	04-06-2006	5:00 - 5:15	22:15 - 22:30	7,3	16.3
Week 12	25-06-2006	4:45 - 5:00	21:00 - 21:15	11,6	29.1

Results

Below, three sets of results will be introduced: 1) the activity level and pattern; 2) the degree of clustering of resting pigs and 3) synchronisation and clustering of eating pigs.

Results 1: Activity level and pattern

Idea: The *ex ante* expectation on degree of activity / resting was that average time budget for inactivity would amount 80%. Also, it was expected that activity levels would be increased in the larger groups relatively to the smaller groups.

Method: From every picture, the number of active (positioned on at least two legs) and inactive pigs (the others) were recorded. Pigs in the nests were not visible on the images and were regarded to be inactive.

Result: During light periods, 20% of the pigs were active, in the darkness this amounted 3%. Overall, 85% of the pigs were in an inactive position.

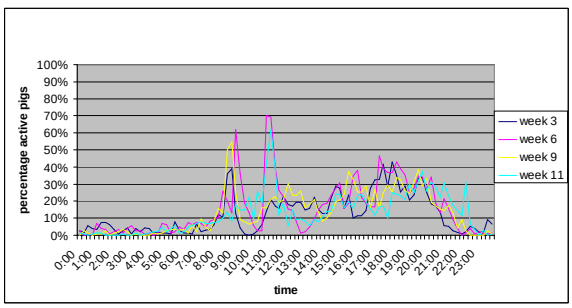

Figure 1.1. Percentage of pigs active as a function of time. Lines indicate the four observation days (week 3, 6, 9 and 12). Data are pooled over the three treatments

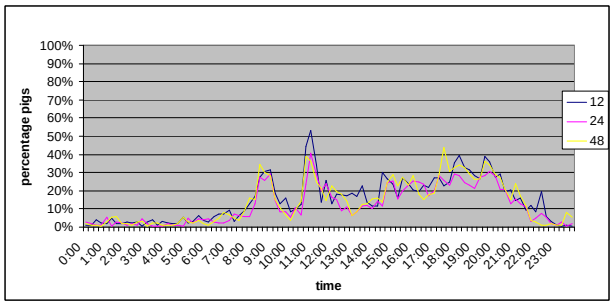

Figure 1.2. Percentage of pigs active as a function of time. Lines indicate the group size (12, 24 and 48 pigs per pen). Data are pooled over the four observation days.

In Figure 1.1, the activity pattern over the day is presented for the four observation days. There is a clear morning and afternoon activity peak.
Visually, there is no systematic distinction in daily pattern between the observation days. The data were assessed from the hypothesis that activity in the larger groups would be increased relative to the smaller groups. 24h mean activity levels amounted 15, 12 and 14% for groups of 12, 24 and 48 pigs, respectively. The pattern of the three treatment groups was very similar (Figure 1.2).
Conclusion: On average, inactivity levels slightly exceeded the expected 80%. Activity levels of the pigs decreased with time; the older / heavier pigs the pigs were, the more time they spent inactive, but the pattern remained similar. Effects of group size on activity level on pattern were not discernable in present data, there are no indications that larger groups of pigs had higher activity levels.

Results 2: Clustering of resting pigs
Idea: In thermoneutral conditions, pigs are generally said to be laying preferably in a side by side position, with some body contact, forming groups defined here as cluster. It was expected that the pigs would be forming clusters of considerable size. Arbitrarily, the hypothetic criterion was put down that the average number of pigs within the clusters would exceed the average number of clusters per pen.
Method: Clusters (inactive pigs with mutual body contact) visible on the images were identified and the number of pigs in each cluster was recorded. Only the pigs outside the restboxes were visible on the images (on average 36% of all pigs present).
Result: 28% of the visible inactive pigs (light hours: 31%; dark hours 21%) was laying individually without body contact to other pigs. The rest was (by definition) clustered. Figure 2.1 shows the frequency distribution of the observed clusters. Of the clustered pigs, cluster size 2 was the predominant cluster size (47% of the clusters, 26% of the clustered pigs). Within pen, the average size of the cluster (3.6) clearly exceeded the average number of clusters in each pen (1.6).

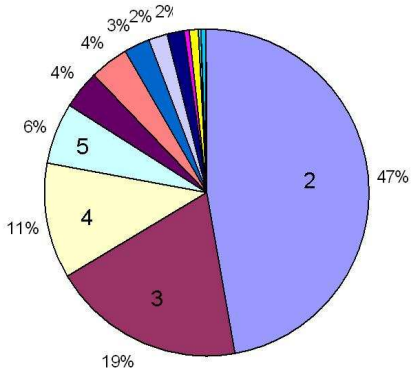

Figure 2.1. Frequency distribution of the size of the pig clusters (based on 14741 observed resting pigs in 4073 clusters).

Conclusion: the inactive pigs that were lying outside the nests were rather clustering than spacing, but with a considerable number of small clusters. Nearly half the number of pigs was lying on its own of with only one other pig.

Results 3: Synchronicity and clustering of feeding behaviour
Idea: Pigs are social animals, so they are expected to synchronise their feed intake behaviour. The hypothesis was that substantially more pigs eat together with other pigs than eating on their own. Also, the distance between pigs was a point of interest: do they cluster (reduce their mutual distance) or space (increase their mutual distance)?
Method: all images concerning day light observations were analysed for the number of pigs active on the feeders. Also, the degree of spacing of duo's of eating pigs was assessed by recording the number of feeder places between the two eating pigs. The mutual space in groups of pigs larger than 2 was not analysed.
Result:
Synchronisation: The feeders were in use during 25% of the daylight time, thus on 75% of the observations, all 6 feeding places were not in use. The frequency distribution of number of pigs eating for all meals is presented in Figure 3.1. More than half of all observed meals was performed by one pig on its own. Of the meals taken with other pigs the predominant part is with only one other pig. From the figure, it can be derived that 3 feeders for 12 pigs is sufficient for 95% of all meals and 4 feeders meets the social eating habits for 99% of all meals.

Clustering: The dataset contained 349 observations of two pigs eating at the same time. In Figure 3.2, the *observed* frequency distribution of distances between these two pigs is compared to the distribution that can be *expected* when the two pigs would randomise their positions on the feeder. The figure indicates that the observed distribution is shifted to the left compared to the expected distribution. Thus, the average distance between pigs was lower than could be expected from random positioning at the feeders.

Conclusion: Synchronicity in feeding behaviour is limited. Despite the clear activity peaks during the day (see part 1), most pigs eat alone. Thus synchronisation in eating behaviour is limited despite the ample opportunities for it. Furthermore, the pigs clearly do not eat in substantial sub-groups. When eating at the same time, pigs rather reduced their mutual distance (clustering) than increased it (spacing).

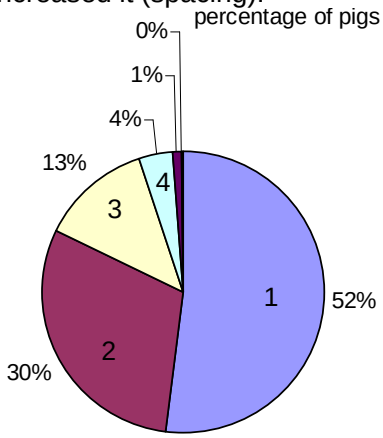

Figure 3.1 Frequency distribution of the number of pigs visiting the feeder at the same time (clockwise 1: 52%; 2: 30%; 3: 13%; 4: 4%,5: 1% and 6 pigs: 0% of the observations

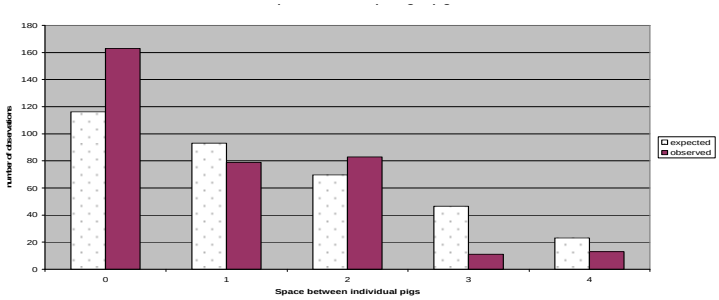

Figure 3.2 Frequency distribution of the space (number of feeding places) left open between two eating pigs eating as a duo. Left (open) bars: expected frequency; right (filled) bar: observed frequency.

Conclusions and concluding remarks

This exploratory work allows the following conclusions to be drawn:

- The results support the well known phenomenon that pigs synchronise their activities. The activity pattern showed the common two activity peaks and the substantial periods in which the vast majority of the pigs was resting.
- The data provided no indications that increase in group size from 12 to 24 or 48 had large effects on levels of activity or synchronisation.
- The degree of synchronisation of eating behaviour is limited. Most meals are taken alone.
- There is clustering in both lying behaviour and eating behaviour. The deliberate reduction of the mutual space is especially obvious in laying behaviour, but also present while eating.

It has to be stressed that these conclusions are based on only one experimental batch of pigs (144 pigs, a total of 4608 observations) and on only numerical and graphical analysis. Future work will add the results of the 3 batches of pigs that have been observed since and will comprise statistical analysis. Also, day to day variation in ambient temperature (up to well above the comfort zone at the last observation day) has affected the results, but the conclusions also hold for the individual days. Two completely other and more principal points that have to be addressed in future studies are 1) the reasoning whether data on synchronisation and clustering have a value for animal welfare judgements and 2) introduction of referenced methods for assessment of synchronisation and clustering.