# Recent published research on gestation sow housing

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# Search terms for the talk

- Journal
  - Journal of Animal Science
- Terms
  - Sow + gestation + housing
- Time
  - January to December 2012
- Search conclusion; n = 4 peer review papers
  - Salak-Johnson et al., 2012 – pen space and effects on behavior and immunity
  - Li et al., 2012 – managing groups
  - Kirchner et al., 2012 – individual feeding in groups
  - Canaday et al., 2012 – lighting and temperatures for stalled sows

# Space allowance for gestating sows in pens: Behavior and immunity[1]

**J. L. Salak-Johnson,[2] A. E. DeDecker, M. J. Horsman, and S. L. Rodriguez-Zas**

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**ABSTRACT:** Different floor space allowances for dry, pregnant sows in pens were evaluated to determine the impacts of space on sow behavior, immune, and cortisol measures. The experiment consisted of 6 replications (blocks 1 to 6; n = 20 sows/group), and within each replicate, physiological measurements were recorded for 2 consecutive pregnancies. A total of 152 sows were measured at 1 gestation, and 65 of those sows were measured at the successive gestation (n = 217). Groups of 5 sows/pen were assigned to 1.4, 2.3, or 3.3 $m^2$ of floor space/sow or of 5 sows in individual stalls (1.34 $m^2$). Behavior measures were stand, sit, lie, walk, drink, oral-nasal-facial (ONF), sham chew, and aggression. Immune traits included both descriptive and functional aspects and cortisol. At d 90 ± 5 of gestation, the occurrence of ONF behaviors increased from 0300 to 1500 h, and lying behavior decreased from 0700 to 1100 h for sows kept at 2.3 $m^2$. Sows in stalls displayed more ($P < 0.05$) ONF from 1500 to 2300 h. Stand, sit, drink, ONF, and sham-chew behaviors were affected by floor space; sows in pens at 2.3 $m^2$ performed more ONF, and sows at 1.4 $m^2$ performed more sham chewing ($P < 0.05$). Standing ($P = 0.05$) and drinking ($P = 0.06$) were increased, but lying ($P = 0.06$) was reduced for sows in pens at 2.3 or 3.3 $m^2$. Sitting and drinking were greater but lying was less for sows in stalls compared with sows in pens ($P < 0.01$). Immune traits were affected by treatment ($P < 0.05$); neutrophils were less and lymphocytes were greater, resulting in a reduced neutrophil:lymphocyte (N:L) ratio ($P < 0.05$) for sows in pens at 3.3 $m^2$. Natural killer cell was greater but lymphocyte proliferation was less for sows in pens at 1.4 $m^2$ ($P < 0.05$). Sows in stalls had greater N:L ratio than sows in pens ($P < 0.05$). For sows in pens, linear and quadratic responses were detected for behavior and immune traits. As floor space increased, walking and aggression increased. As floor space decreased, neutrophils, N:L, and natural killer cell increased, but as floor space increased lymphocyte proliferation increased. On the basis of behavioral and physiological responses shown by sows in all 4 environments it is apparent that neither floor space nor stall environment provided adequate or quality of space to improve sow well-being. However, the differential behavioral and physiological mechanisms initiated by sows in response to their specific environment the sows were able to evoke the appropriate response(s) needed to adequately adapt to their environment.

**Key words:** behavior, group pen, immune, sow, stall



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# Study objective

***The primary objective of this study was to determine the impacts of floor space allowance for dry sows in pens (group size constant) and floor feeding on behavior and immune traits. Differential effects of keeping sows in individual stalls vs. pens on traits were evaluated***

# Animals and housing

- **Cross-bred (PIC) sows (n = 217)**
- **Pens vs. stalls**
- **Parity breakdown**
  - **Parity 1 n = 69**
  - **Parity 2 = 62**
  - **Parity 3 = 44**
  - **Parity ≥ 4 = 42**

***Pens, flooring was partially slatted concrete, with a section of solid concrete for feeding***

***Individual stalls had fully slatted floors equipped with concrete feeding troughs***

# Treatments

- **5 sows were randomly allocated to one of four treatments:**
  - **TRT ONE: 1.4 $m^2$/sow PEN (15.07 $ft^2$)**
  - **TRT TWO: 2.3 $m^2$/sow PEN (24 $ft^2$)**
  - **TRT THREE: 3.3 $m^2$/sow PEN (35.54 $ft^2$)**
  - **TRT FOUR: STALL (2.12 m long x 0.61 m wide) 1.34 $m^2$/sow (14.42 $ft^2$)**

**The EU standard of space requirement in group-gestation housing is 2.23 $m^2$ (24 $ft^2$) for a mature sow, and 1.67 $m^2$ (18 $ft^2$) for a gilt**

# Behavior

**Table 1.** Definitions of observed and registered behaviors

| Behavior | Description |
|---|---|
| Lie | Sow reclining in ventral or lateral position |
| Sit | Sow supported by 2 front legs |
| Stand | Sow supported by all 4 legs |
| Walk | Sow supported by all 4 legs and in motion (not applicable for stall kept sows) |
| Eat | Snout or mouth of sow in contact with feed |
| Drink | Snout or mouth of sow in contact with nipple waterer |
| Sham chew | Mouth of sow chewing in a repetitive motion with nothing present in the mouth or feed present |
| Oral-nasal-facial | Snout or mouth of sow in contact with any object besides food or water |
| Aggression | Sow making a biting, shoving, or antagonistic action toward conspecific |
| Inactivity | Combination of lying and sitting, excluding eat, drink, and oral-nasal-facial |

# Behavior measures

**Table 2.** Main effects of gestation space on frequency of behaviors for sows kept either in pens at various floor pace allowances or individual stalls (least-squares means ± SE)

| | Gestational floor space, $m^2$ | | | | *P*-value | |
|---|---|---|---|---|---|---|
| Behavior, No./h | 1.4 | 2.3 | 3.3 | Stall | Space | Stall vs. pen[1] |
| Lie | $9.8 \pm 0.2^{a,b}$ | $9.7 \pm 0.2^{a,b}$ | $9.9 \pm 0.2^{a}$ | $9.1 \pm 0.2^{b}$ | 0.04 | 0.01 |
| Sit | $0.13 \pm 0.1^{b}$ | $0.011 \pm 0.04^{b}$ | $0.041 \pm 0.04^{b}$ | $0.59 \pm 0.1^{a}$ | <0.001 | <0.001 |
| Stand | $2.0 \pm 0.3$ | $2.2 \pm 0.2$ | $1.9 \pm 0.2$ | $2.3 \pm 0.3$ | 0.31 | 0.25 |
| Walk[2] | $0.01 \pm 0.03^{b}$ | $0.01 \pm 0.03^{b}$ | $0.14 \pm 0.05^{a}$ | — | 0.01 | — |
| Eat | $0.33 \pm 0.1$ | $0.34 \pm 0.11$ | $0.27 \pm 0.1$ | $0.26 \pm 0.1$ | 0.90 | 0.69 |
| Drink | $0.10 \pm 0.04^{b}$ | $0.15 \pm 0.04^{b}$ | $0.13 \pm 0.04^{b}$ | $0.38 \pm 0.1^{a}$ | 0.013 | 0.001 |
| Oral-nasal-facial | $1.9 \pm 0.3^{a,b}$ | $2.1 \pm 0.3^{a}$ | $1.3 \pm 0.3^{b}$ | $2.0 \pm 0.3^{a,b}$ | 0.012 | 0.41 |

[a,b]Within a row, means without a common superscript differ (Scheffé adjusted $P < 0.05$).

[1]Stall vs. pen: contrast between stall and the weighted average of the 3 pen amounts.

[2]Behavior registered only for sows in pens.

***When comparing sows in stalls to all pen groups regardless of space allowance; sows in stalls sat and drank more and laid less***

# Take home from this study

- Behavior serves as an interface between the sow and its environment
- Relationship is affected by internal and external factors
- Chief behavioral restraint of stalls is restriction of movement
  - Laid less and sat more
- ONF occurred most often when sows were housed at 2.3 $m^2$/sow
  - Energetically consuming

# Take home from this study

***Sows were able to initiate an appropriate and adequate biological response to the environment that enable them to adapt without deleterious effects on health and well-being***

***No one system compared in this study excelled by improving or compromising the sows health and well-being in production agriculture***

# Sorting by parity to reduce aggression toward first-parity sows in group-gestation housing systems[1]

**Y. Z. Li,[2] L. H. Wang,[3] and L. J. Johnston**

West Central Research and Outreach Center, University of Minnesota, Morris 56267

**ABSTRACT:** Young sows are subordinate and vulnerable in group-housing systems because they usually lose most fights and suffer more injuries than mature sows at mixing. This study was conducted to evaluate effects of sorting by parity on reducing aggression and associated stress with the aim to improve welfare and performance of first-parity sows in a group-housed system. Sows and gilts (n = 180) from 6 breeding groups were used. Within each group, 2 groups of 15 females were mixed in each of 2 treatment pens after weaning and remained there throughout the entire gestation period. The control pen consisted of 11 multiparous and 4 first-parity sows, and the treatment pen consisted of 11 gilts and 4 first-parity sows. Before mixing and at the end of the gestation period, sows and gilts were weighed individually, assessed for BCS, and measured for backfat thickness. Injury scores were assessed before and 48 h after mixing and wean-to-mating intervals, farrowing rate, and litter performance at the subsequent farrowing were recorded for all females. Aggressive interactions involving first-parity sows were video recorded for 72 h immediately after mixing in each pen. Data were analyzed using the Glimmix procedure of SAS with a Poisson regression model for count data and a Gaussian model for continuous data. All females in treatment pens sustained fewer scratches ($P = 0.01$) after mixing than females in control pens. First-parity sows in treatment pens fought more frequently ($P = 0.01$), tended to fight for longer periods ($P = 0.08$), and won more fights ($P = 0.04$) of parallel pressing but had fewer injures ($P = 0.03$) after mixing, gained more BW ($P = 0.01$) during gestation, and had greater farrowing rates ($P = 0.03$) compared with first-parity sows in control pens. The results suggest that sorting by parity shielded first-parity sows from severe injuries caused by mixing-induced aggression so that their welfare and performance can be improved in group housing systems.

**Key words:** aggression, gestation housing, parity, sows



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# Study objective

***Investigated effects of sorting by parity on aggression, associated stress, and performance of young sows in a group-housed gestation system***

# Animals and housing

- Gestating sows and gilts (Yorkshire × Landrace) were group housed in a straw-bedded hoop barn
- Barn had 4 pens, which accommodated 15 animals/pen
- Equipped with individual feeding stalls and a bowl drinker with 2 drinking spaces
- Space allowance in each pen was 3.7 $m^2$ excluding the area occupied by feeding stalls and the water drinker

# Treatments

- **Control (sow-pen): observed in a commercial setting (1st parity [n=4] and multiparous sows [n=11])**

- **Treatment (gilt-pen) (1st parity [n=4] and gilts [n=11])**

# Reproduction

**Table 3.** Performance of first-parity sows in a group-housed gestation system

| Item | Treatment | | Pooled | |
|---|---|---|---|---|
| | Sow-pen[1] | Gilt-pen[2] | SE | *P*-value |
| Total number of first-parity sows | 24 | 24 | – | – |
| Number of first-parity sows farrowed | 12 | 18 | – | – |
| Reproductive performance | | | | |
| Wean-to-mating interval, d | 5.1 | 4.7 | 0.39 | 0.20 |
| Gestation length, d | 115.6 | 116.2 | 0.45 | 0.38 |
| Litter size, piglets/litter: | | | | |
| Total born | 11.5 | 11.3 | 0.87 | 0.87 |
| Born alive | 10.3 | 10.7 | 0.86 | 0.74 |
| Stillborn | 0.82 | 0.46 | 0.22 | 0.21 |
| Mummified | 0.06 | 0.04 | 0.05 | 0.86 |
| BW, kg | | | | |
| At mixing in gestation pens[3] | 207 | 201 | 4.8 | 0.34 |
| Before farrowing[4] | 232 | 257 | 6.2 | 0.01 |
| Gain during gestation[4] | 36 | 59 | 6.3 | 0.01 |
| BCS | | | | |
| At mixing in gestation pens[3] | 3.0 | 2.8 | 0.35 | 0.61 |
| Before farrowing[4] | 2.9 | 3.1 | 0.46 | 0.81 |
| Backfat thickness, mm | | | | |
| At mixing in gestation pens[3] | 15.9 | 14.8 | 0.94 | 0.19 |
| Before farrowing[4] | 16.1 | 16.4 | 1.53 | 0.71 |

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| BW, kg | | | | |
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# Injury Scores; 48-h after mixing

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|---|---|---|---|---|
| | Sow-pen[1] | Gilt-pen[2] | SE | *P*-value |
| Injury scores[4,5] | | | | |
| Before mixing | | | | |
| Head and shoulders[6] | 0.8 | 0.3 | 0.34 | 0.33 |
| Body[7] | 0.4 | 0.2 | 0.15 | 0.25 |
| Total[8] | 1.2 | 0.5 | 0.44 | 0.24 |
| After mixing[9] | | | | |
| Head and shoulders | 5.3 | 5.0 | 0.78 | 0.72 |
| Body | 7.3 | 3.0 | 0.86 | <0.001 |
| Total | 12.6 | 8.0 | 1.53 | 0.03 |

# Aggression; First 72-h

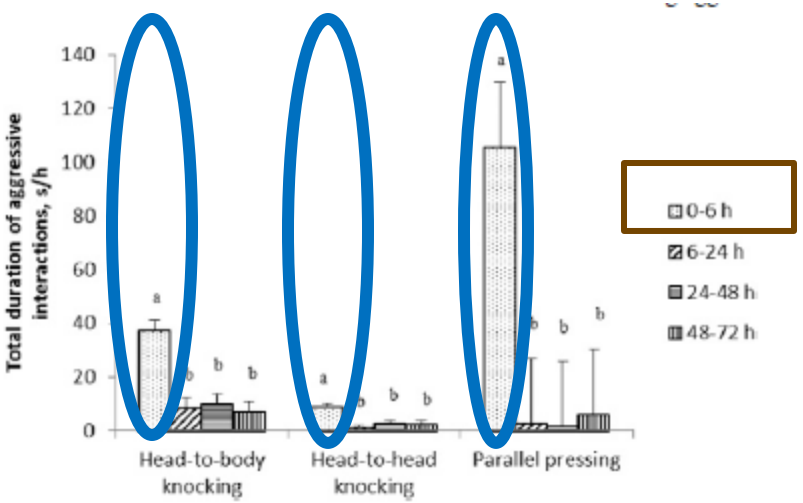



**Figure 1.** Total duration of aggressive interactions involving first-parity sows during the first 72 h after mixing in a group-housed gestation system. Means of head-to-body knocking ($P < 0.001$), head-to-head knocking ($P < 0.001$), and parallel pressing ($P < 0.001$) for the period of 0 to 6 h were greater than those for the other periods.

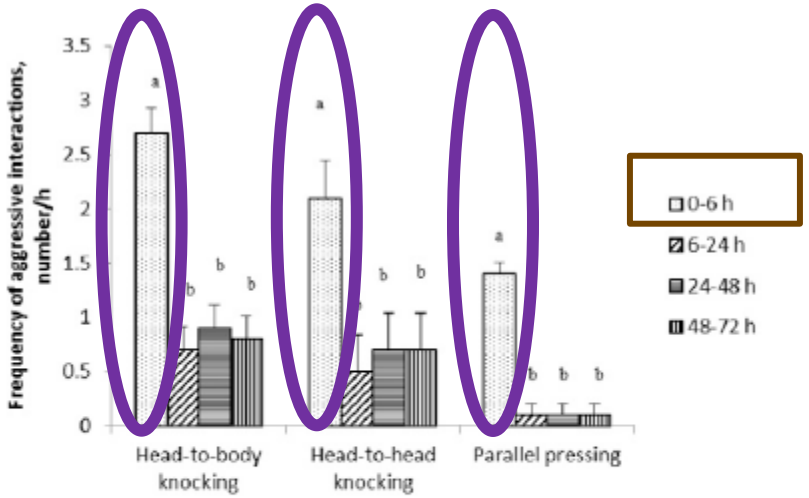



**Figure 2.** Frequency of aggressive interactions involving first-parity sows during the first 72 h after mixing in a group-housed gestation system. Means of head-to-body knocking ($P < 0.001$), head-to-head knocking ($P < 0.001$), and parallel pressing ($P < 0.001$) for the period of 0 to 6 h were greater than those for the other periods.

**Total duration s/h**

**Frequency number/h**

**These numbers are for first parity sows**

# Aggression: First 72-h

- Gilt-pen vs. Sow-pen
  - Fought more frequently
    - 9 vs. 5.7 fight/h; *P* = 0.01
  - Tended to fight for a greater period of time
    - 67 vs. 29.9 s/h; *P* = 0.08
  - More head-to-body fights
    - 6.6 vs. 4.5 fight/h; *P* = 0.03
  - More parallel pressing
    - 0.8 vs. 0.3 fight/h; *P* = 0.04
  - Tended to parallel press longer
    - 43.9 vs. 14 s/h; *P* = 0.08
  - Won more parallel pressing fights
    - 46.4 vs. 18.3 %; *P* = 0.04

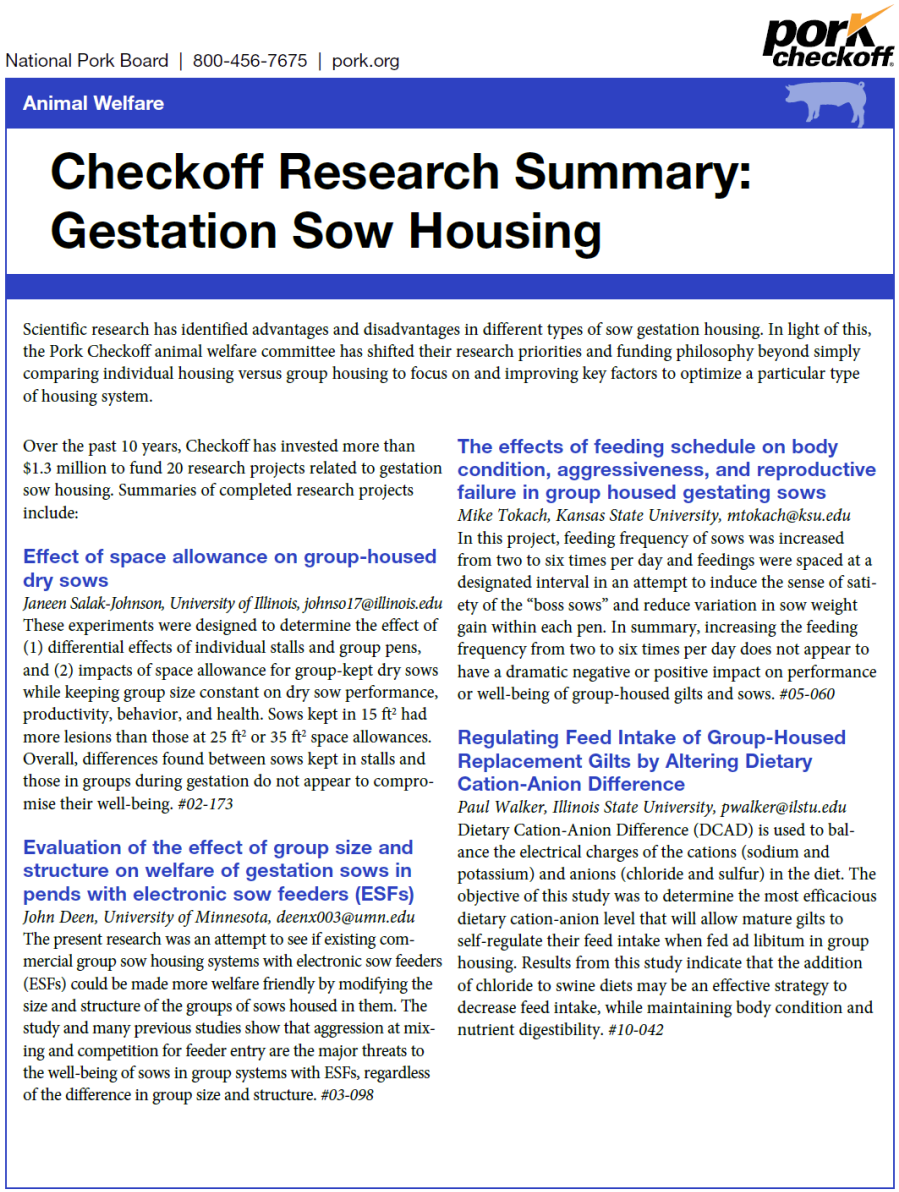
# Take home from this study

- Most fighting involving first parity sows occurred within the 6-h of mixing
- First parity sows in gilt-pens at mixing (72-h)
  - Fought more frequently
  - Tended to fight longer
  - Won more fights parallel pressing
- First parity sows in gilt-pens had fewer injuries
- First parity sows in gilt-pens gained more BW during gestation

# Take home from this study

***Suggest that farmers should consider dividing their herd into gilt and first parity groups and multiparous (2$^{nd}$ parity+) and house the groups in separate pens to improve well-being and performance of first parity sows***

# Heads up



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Animal Welfare

## Checkoff Research Summary: Gestation Sow Housing

Scientific research has identified advantages and disadvantages in different types of sow gestation housing. In light of this, the Pork Checkoff animal welfare committee has shifted their research priorities and funding philosophy beyond simply comparing individual housing versus group housing to focus on and improving key factors to optimize a particular type of housing system.

Over the past 10 years, Checkoff has invested more than $1.3 million to fund 20 research projects related to gestation sow housing. Summaries of completed research projects include:

### Effect of space allowance on group-housed dry sows

*Janeen Salak-Johnson, University of Illinois, johnso17@illinois.edu*

These experiments were designed to determine the effect of (1) differential effects of individual stalls and group pens, and (2) impacts of space allowance for group-kept dry sows while keeping group size constant on dry sow performance, productivity, behavior, and health. Sows kept in 15 ft² had more lesions than those at 25 ft² or 35 ft² space allowances. Overall, differences found between sows kept in stalls and those in groups during gestation do not appear to compromise their well-being. *#02-173*

### Evaluation of the effect of group size and structure on welfare of gestation sows in pends with electronic sow feeders (ESFs)

*John Deen, University of Minnesota, deenx003@umn.edu*

The present research was an attempt to see if existing commercial group sow housing systems with electronic sow feeders (ESFs) could be made more welfare friendly by modifying the size and structure of the groups of sows housed in them. The study and many previous studies show that aggression at mixing and competition for feeder entry are the major threats to the well-being of sows in group systems with ESFs, regardless of the difference in group size and structure. *#03-098*

### The effects of feeding schedule on body condition, aggressiveness, and reproductive failure in group housed gestating sows

*Mike Tokach, Kansas State University, mtokach@ksu.edu*

In this project, feeding frequency of sows was increased from two to six times per day and feedings were spaced at a designated interval in an attempt to induce the sense of satiety of the "boss sows" and reduce variation in sow weight gain within each pen. In summary, increasing the feeding frequency from two to six times per day does not appear to have a dramatic negative or positive impact on performance or well-being of group-housed gilts and sows. *#05-060*

### Regulating Feed Intake of Group-Housed Replacement Gilts by Altering Dietary Cation-Anion Difference

*Paul Walker, Illinois State University, pwalker@ilstu.edu*

Dietary Cation-Anion Difference (DCAD) is used to balance the electrical charges of the cations (sodium and potassium) and anions (chloride and sulfur) in the diet. The objective of this study was to determine the most efficacious dietary cation-anion level that will allow mature gilts to self-regulate their feed intake when fed ad libitum in group housing. Results from this study indicate that the addition of chloride to swine diets may be an effective strategy to decrease feed intake, while maintaining body condition and nutrient digestibility. *#10-042*

**Checkoff funded work – contact 1-800-PORK or Sherrie Niekamp Director Animal Welfare**

# THANK YOU FOR YOUR ATTENTION