

Proceedings of the 13th
ISAE North-American
Regional Meeting



May 12-13, 2017

Iowa State University

Ames, IA, USA

Organizing and scientific committee:

Suzanne T. MILLMAN, Anna K. JOHNSON,
Yolande M. SEDDON, Peter KRAWCZEL and Nicolas DEVILLERS

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Janice Siegford, Maja Makagon, Jeremy Marchant-Forde,
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has been generously provided by**

IOWA STATE UNIVERSITY

Department of Animal Science



The Campbell Centre for the
Study of Animal Welfare

Program Overview

Friday, May 12 – Scheman Building, ISU Campus

| | |
|---------------|---|
| 08:30 – 09:00 | Registration opens & Poster set-up |
| 09:00 – 09:15 | Meeting opening |
| 09:15 – 10:30 | Oral session: Social behavior of pigs |
| 10:30 – 11:00 | Coffee break and 1st Poster session |
| 11:00 – 12:15 | Oral session: Housing & Enrichment |
| 12:15 – 13:30 | Lunch |
| 13:30 – 15:00 | Oral session: Welfare assessment |
| 15:00 – 15:30 | Coffee break and 2nd Poster session |
| 15:30 – 16:30 | Keynote Lecture: Dr. Cheryl L. MORRIS (Omaha’s Henry Doorly Zoo and Aquarium) Advancements in Animal Care Through Training |
| 17:30 | Appetizer Reception and Cash Bar at Reiman Gardens |
| 18:30 | Banquet at Reiman Gardens |

Saturday, May 13 – Scheman Building, ISU Campus

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|---------------|---|
| 09:00 – 10:00 | Oral session: Health & Pain relief |
| 10:00 – 10:30 | Coffee break and 3rd Poster session |
| 10:30 – 11:05 | ISAE Business Meeting |
| 11:05 – 11:15 | 2018 ISAE international congress |
| 11:15 – 11:45 | Oral session: Behavioral variability |
| 11:45 – 12:15 | Awards, closing discussion and meeting adjournment |
| Afternoon | Excursions (optional) |

General Information

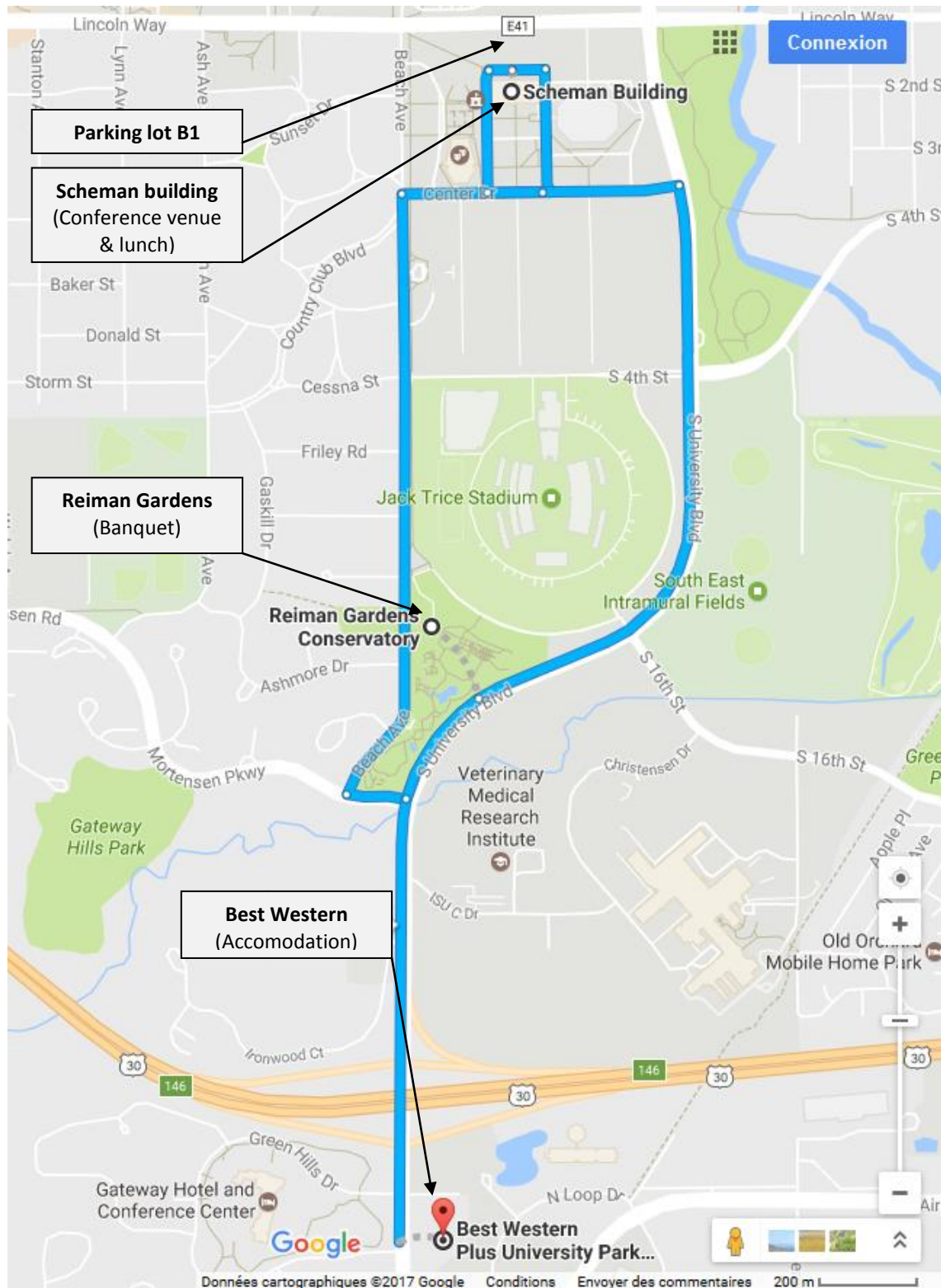
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Map of the Venue and Surrounding Area



Keynote Lecture

Friday, May 12: 15:30-16:30

Dr. Cheryl L. Morris (Omaha's Henry Doorly Zoo and Aquarium)

Advancements in Animal Care through Training

Dr. Cheryl L. Morris serves as Chief Conservation Officer at Omaha's Henry Doorly Zoo and Aquarium and is the owner of Evolve Animal Services, LLC a nutrition consulting business specializing in raw meat and clinical diet formulations for animals. Previously, Dr. Morris served as the zoo's Director of Comparative Nutrition and as a faculty member at Iowa State University in the Department of Animal Science. Although Dr. Morris has published research related to nutrition and enrichment of insects, giraffe and geckos, her research passion has been raw meat diets for domestic and zoo carnivores. In her spare time, she trains and competes with her dogs in canine agility. Dr. Morris and her dogs have competed at the upper levels of AKC and USDAA agility including 11 finals rounds at the AKC Agility Invitational, AKC National Agility Championship and the Cynosport World Games, winning the 2013 AKC National Agility Championship 16-Inch Division with her rescue border collie, Karma.



Oral presentations

Presenting author underlined

Friday, May 12th: 09:15-10:30

Social behavior of pigs

- 9:15 Social network analysis of group housed gestating sows**
Kristina M. Horback, Meghann K. Pierdon, Thomas D. Parsons
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- 9:30 Agonistic interactions in swine housed in a retrofitted gestation group housing pen with a gated electronic sow feeder**
Magnus R. Campler, Justin D. Kieffer, Monique D. Pairis-Garcia
 Page 13
- 9:45 Effects of social status on enrichment use in group housed gestating sows**
Victoria Kyeiwa, Denise A. Beaulieu, Yolande M. Seddon, Laurie M. Connor, Jennifer A. Brown
 Page 14
- 10:00 Analysis of swine aggression when stable groups are moved to novel pens**
Grace E. Flynn, Kaitlin E. Wurtz, Carly I. O'Malley, Juan P. Steibel, Ronald O. Bates, Catherine W. Ernst, Janice M. Siegford
 Page 15 *Undergraduate Student Competition*
- 10:15 The relationship between social aggression and play behavior in finisher pigs: do pigs that play less fight more?**
Hannah E. Pearsall, Alexis F. Hinson, Carly I. O'Malley, Kaitlin E. Wurtz, Juan P. Steibel, Ronald O. Bates, Catherine W. Ernst, Janice M. Siegford
 Page 16 *Undergraduate Student Competition*

Friday, May 12th: 11:00-12:15

Housing & Enrichment

- 11:00 Dairy cows and heifers prefer to calve in a bedded pack barn or natural forage compared to open pasture**
Erika M. Edwards, Katy L. Proudfoot, Heather M. Dann, Peter D. Krawczel
 Page 17 *Graduate Student Competition*
- 11:15 The effects of access to pasture, winter exercise, and modified stalls on the welfare and behaviours of dairy cows kept in tie-stalls**
Santiago Palacio, Steve Adam, Renée Bergeron, Doris Pellerin, Anne Marie de Passillé, Jeff Rushen, Derek B. Haley, Trevor J. DeVries, Elsa Vasseur
 Page 18 *Graduate Student Competition*
- 11:30 Effects of nursery space allowance on the behavior and salivary cortisol levels of weaned pigs**
Ravneet Kaur, Yolande M. Seddon, Dan Bussieres, Sandra A. Edwards, Jennifer A. Brown
 Page 19 *Graduate Student Competition*
- 11:45 It's no laughing matter: cage color and light intensity alter rat affect**
Megan R. LaFollette, Melissa P. Swan, Brianna N. Gaskill
 Page 20 *Graduate Student Competition*

Friday, May 12th: 11:00-12:15 Housing & Enrichment

12:00 Behavioral responses of Allegheny woodrats to fluctuating enrichment stimuli and their implications for reintroduction programs

Lindsey A. Robbins, Olivia L. Vaught, Timothy J. Smyser, Robert K. Swihart, Brianna N. Gaskill

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Graduate Student Competition

Friday, May 12th: 13:30-15:15 Welfare assessment

13:30 Pekin duck welfare assessment: a comparison of methods

Essam M. Abdelfattah, Giuseppe Vezzoli, Maja. M. Makagon

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13:45 Impacts experienced at the keel and development of keel bone damage in laying hens in enriched housing systems

Sydney L. Baker, Cara I. Robison, Darrin M. Karcher, Michael J. Toscano, Maja M. Makagon

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Graduate Student Competition

14:00 Examining the efficacies of two non-penetrating captive bolt devices for the on-farm euthanasia of broiler breeders

Lilia Serpa, Tina M. Widowski, Penny Lawlis, Karen Schwean-Lardner, Patricia V. Turner, Stephanie Torrey

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Graduate Student Competition

14:15 Aversion to argon-induced hypoxia in pigs using approach-avoidance and conditioned place avoidance paradigms

Luna KC, Mhairi A. Sutherland, Anna K. Johnson, Timothy A. Shepherd, Hongwei Xin, Kenneth J. Stalder, Locke A. Karriker, Donald C. Lay, Jr, Suzanne T. Millman

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Graduate Student Competition

14:30 Associations between tail lesions and other injurious behaviours and health deviations in pigs

Nienke van Staaveren, Alison Hanlon, Julia A. Calderón Díaz, Laura Boyle

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14:45 The effect of 24 hour lying and sleep deprivation on energy balance, behavior, and milk yield

Jessie A. Kull, Gina M. Pighetti, Katy L. Proudfoot, Jeffrey M. Bewley, Bruce F. O'Hara, Kevin D. Donohue, Peter D. Krawczel

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Graduate Student Competition

Saturday AM 9:00-10:00 Health & Pain relief

- 09:00 Relationship between the clinical and behavioral response to a mastitis challenge with *Streptococcus uberis* from Holstein dairy cows**
Victoria L. Couture, Peter D. Krawczel, Raúl A. Almeida, Gina M. Pighetti, Stephen P. Oliver
Page 28 *Graduate Student Competition*
- 09:15 Behavioral changes in group-housed dairy calves infected with *Mannheimia haemolytica***
Catherine L. Hixson, Peter D. Krawczel, J. Marc Caldwell, Emily K. Miller-Cushon
Page 29 *Graduate Student Competition*
- 09:30 The pain responses of piglets after castration when using three different analgesics: Results from a behavioural test**
Erin L. Davis, Yolande M. Seddon, Jennifer A. Brown
Page 30 *Graduate Student Competition*
- 09:45 Clinical trial of local anesthetic protocols for acute pain associated with caustic paste disbudding in dairy calves**
Charlotte B. Winder, Stephen J. LeBlanc, Derek B. Haley, Kerry D. Lissemore, M. Ann Godkin, Todd F. Duffield
Page 31 *Graduate Student Competition*

Saturday AM 11:15-12:00 Behavioral variability

- 11:15 Genome wide association analyses of lesion scores in group-housed swine**
Kaitlin E. Wurtz, Juan P. Steibel, Ronald O. Bates, Catherine W. Ernst, Nancy E. Raney, Janice M. Siegford
Page 32 *Graduate Student Competition*
- 11:30 Consistency over time of individual activity budgets by gestating sows housed in ESF pens**
Kristina M. Horback, Ilana Yablonovich, Thomas D. Parsons
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Posters

Presenting author underlined

Friday AM 10:30-11:00 First Poster Session

- 1 **Characterizing standing behavior at social grouping in weaned dairy calves**
Kelsey C. Horvath and Emily K. Miller-Cushon
 Page 35 *Graduate Student Competition*
- 2 **Evaluation of single vs. paired calf housing on behavior and immunity of Holstein calves: A proposal**
Clay B. Kesterson, Peter D. Krawczel, Gina M. Pighetti
 Page 36 *Graduate Student Competition*
- 3 **Sows' preferences for different fresh and dry mixed forages**
Lydiane Aubé, Frédéric Guay, Renée Bergeron, Gilles Bélanger, Gaëtan F. Tremblay, Nicolas Devillers
 Page 37 *Graduate Student Competition*

Saturday AM 10:00-10:30 Second Poster Session

- 4 **It's getting hot in here: A preliminary study to evaluate the impact of in utero heat stress on piglet behavior after weaning and transport**
Christopher J. Byrd, Nichole M. Chapel, Drew W. Lugar, Matthew C. Lucy, Timothy J. Safranski, Jay S. Johnson
 Page 38 *Graduate Student Competition*
- 5 **Effects of probiotics on anxiety-like behavior in weaned pigs**
Morgan B. Garvey, Elizabeth Petrosus, Jeremy N. Marchant-Forde, Susan D. Eicher
 Page 39 *Graduate Student Competition*
- 6 **An aural-visual classification of the vocal repertoire of adult pigs (*Sus scrofa domestica*)**
Kathryn Y. Henley, Je'Vana L. Pickens, Betty Pat, Virginia Aida, Candace L. Floyd
 Page 40 *Graduate Student Competition*
- 7 **Do different behavior tests measure similar personality dimensions in domestic pigs?**
Carly I. O'Malley, Kaitlin E. Wurtz, Juan P. Steibel, Ronald O. Bates, Catherine W. Ernst, Janice M. Siegford
 Page 41 *Graduate Student Competition*

Saturday AM 10:00-10:30 Third Poster Session

- 8 Comparison of perching behavior and its effects on keel bone deviations of laying hens in two types of enriched colony cages**
Ashley K. Birakos, Jordan M. Tonooka, Sydney L. Baker, Cara I. Robison, Nick Chargo, Darrin M. Karcher, Michael J. Toscano, Maja M. Makagon
Page 42 *Undergraduate Student Competition*
- 9 Comparing measurements of different behavioral responses between a novel environment test and a novel object test in domestic swine**
Briana C. Dewberry, Carly I. O'Malley, Kaitlin E. Wurtz, Juan P. Steibel, Ronald O. Bates, Catherine W. Ernst, Janice M. Siegford
Page 43 *Undergraduate Student Competition*
- 10 Influence of genetic strain on resource use by four strains of laying hens in a non-cage aviary**
Ahmed B.A. Ali, Dana L.M. Campbell, Darrin M. Karcher, Janice M. Siegford
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- 11 Frequency of culling by sow housing type as reported by North American pork producers**
Sarah H. Ison, Ronald O. Bates, Juan P. Steibel, Catherine W. Ernst, Janice M. Siegford
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ABSTRACTS FOR ORAL PRESENTATIONS

Oral Session: Social behavior of pigs

Social network analysis of group housed gestating sows

Kristina M. Horback¹, Meghann K. Pierdon², Thomas D. Parsons²

¹Department of Animal Science, University of California Davis, 1 Shields Ave, Davis, CA 95616 USA (kmhorback@ucdavis.edu)

²Swine Teaching and Research Center, University of Pennsylvania, School of Veterinary Medicine, 382 W Street Road, Kennett Square, PA, 19348 USA (mpierdon@vet.upenn.edu, thd@vet.upenn.edu)

In group housing systems, sows form hierarchical social structures with older, larger sows being more dominant than younger sows. Establishment of this hierarchy can result in increased injury or reduced welfare for the younger sows. Given that the details of this social structure are poorly understood beyond the initial mixing phase, the social network of a multiparous gestational pen was examined over one year. The resting location of 130 sows (parity 1 n=27, parity 2-3 n=40, parity 4-5 n=26, parity 6-7 n=37) housed in one large pen (2.4 m²/sow) was recorded twice a week for one year. Location data were transformed into proximity data, with sows considered to be resting near another sow if the distance between the two was less than 1 m. The half-weight index was calculated per dyad in order to obtain a standardized metric of association. Social network analysis (igraph) and statistical testing (ANOVAs, Bonferroni post hoc) were performed in R 3.3.2. The clustering coefficient for the pen was 0.64, meaning that 64% of sows were connected by neighbors. Parity 4-5 sows (42.9±4.3) had a significantly greater betweenness centrality (P<0.001), or linked more associations, than primiparous sows (20.5±3.2). A dyad was identified as having a preferred association when their half-weight index was ten times the expected value if associations were completely random. Primiparous sows (5.7±0.9) had significantly more (P<0.001) preferred associations than parity 6-7 sows (1.9±0.4), while parity 6-7 sows (39.4±3.6) had a significantly greater number of total associations (P<0.01) than primiparous sows (24.3±4.6). Primiparous sows (0.7±0.02) had significantly (P<0.01) greater clustering coefficient than parity 2-3 (0.6±0.01), parity 4-5 (0.6±0.01) and parity 6-7 (0.6±0.01) sows. This indicates that primiparous sows rested preferentially near other primiparous sows while the older sows did not rest preferentially near similar parity sows. The high degree assortativity for this network (0.5) indicates that sows rested preferentially near other sows with a similar level of sociality. Knowledge of the social network in pen gestation highlights the complexity of animal interactions in loose housing and promises to provide insight into management strategies targeting improved animal care of vulnerable individuals such as primiparous sows.

Oral Session: Social behavior of pigs

Agonistic interactions in swine housed in a retrofitted gestation group housing pen with a gated electronic sow feeder

Magnus R. Campler, Justin D. Kieffer, Monique D. Pairis-Garcia

Department of Animal Sciences, College of Food, Agricultural, and Environmental Sciences, Ohio State University, Ohio (campler.1@osu.edu, kieffer.22@osu.edu, pairis-garcia.1@osu.edu)

To promote swine welfare during gestation, producers are transitioning from individual crate housing to group housing systems. Aggression is a common behavior performed in group housed sows during the initial 48h of mixing or during re-mixing periods if the farm is utilizing dynamic groups. Gilts with no prior experience of group housing or pen mates may be more likely to perform aggressive behaviors. Therefore, identifying ways to mitigate aggression is a critical area of current focus in sow housing research and especially for gilts. The objective of this study was to quantify the level of agonistic encounters (n.o. initiated bouts and pen location) in gilts across their first (Parity=0) and consecutive (Parity=1) gestation period in a retrofitted gestation group housing using a gated Electronic Sow Feeder (ESF). Twenty-one gilts were housed in a group gestation pen (6.8 x 5.5m) with an ESF and two water nipples located on the sides of the pen. The number of initiated agonistic bouts (Biting, Chasing, and Displacing) and corresponding pen location (A: no resource with concrete flooring (NR); B: water nipples with concrete slatted flooring (W), and C: ESF with concrete flooring) were recorded for each sow continuously over 48h for both gestation periods. Individuals were grouped into categories depending on the level of agonistic initiation (top 25%, middle 50%, and bottom 25%). Data were analyzed using a PROC Glimmix procedure in SAS 9.4 with a Bonferroni correction. A higher number of initiated agonistic bouts were found during the first gestation period compared to the second (9.6 ± 0.9 and 7.5 ± 0.7 , mean bouts \pm SE, $P < 0.0001$) and more agonistic bouts were seen around the ESF across both gestation periods compared to W and NR (13.1 ± 1.4 , 8.6 ± 0.9 and 4.4 ± 0.6 , mean bouts \pm SE, $P < 0.0001$). The top 25% category initiated more agonistic bouts regardless of pen location compared to the middle 50% and the bottom 25% (23.1 ± 2.6 , 11.2 ± 1.0 , and 2.4 ± 0.4 , mean bouts \pm SE, $P < 0.0001$). The results from this study indicates that aggression levels may decrease between gestations periods if swine are kept in stable groups and that resource guarding may be a welfare concern as most agonistic interactions were seen around the ESF.

Oral Session: Social behavior of pigs

Effects of social status on enrichment use in group housed gestating sows

Victoria Kyeiwaa^{1,2}, Denise A. Beaulieu^{1,2}, Yolande M. Seddon^{1,2}, Laurie M. Connor³, Jennifer A. Brown^{1,2}

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Providing environmental enrichment may reduce aggression and improve the welfare of sows; however, if enrichment is considered a valuable resource, then dominant individuals may obtain greater access than subordinates. This study observed the effects of four enrichment treatments on behaviour and enrichment use in sows of differing social status. Eight groups of 28 sows were studied, with additional data collected on six focal animals (3 dominant [Dom] and 3 subordinate [Sub]) per group, identified using a feed competition test. Each group received four treatments in random order, with each treatment lasting for 2 weeks. Treatments consisted of: 1) Constant provision of wood enrichment, 2) Rotation of three objects (rope, straw, wood), 3) Stimulus: rotation of three objects with an associative stimulus and 4) No objects. Cameras were mounted over pens and time lapse photos taken on days 1,8,10 and 12 to determine enrichment use and postures of sows. Initial and final body weights of sows were recorded, and aggression was evaluated using skin lesion scores on a scale of 0 (no injury) to 3 (severe injury). Body weight was analysed using Proc Mixed and treatment and dominance effects were analyzed using Proc Glimmix in SAS 9.4. Dom sows were of higher average parity (Dom: 3.11±0.09; Sub: 2.89±0.08) and significantly heavier than Sub sows (Mean BW±SD, Dom: 258.6 ±33.1; Sub: 236.2 ±28.4 kg; P<0.001). Sows spent more time contacting and near the enrichment when materials were rotated than constant (% of observations within 1 M; Constant: 0.65 ±0.07; Rotate: 4.23 ±0.43; Stimulus: 2.61 ±0.21, mean ±SE). Sows in the Rotation treatment were observed more frequently within 1M of the enrichments on day 10 when straw was provided (19.77±0.96% of time; P<0.001) compared to days 1, 8 or 12. Social status did not affect the number of sows present in the enrichment area (P=0.200). More Dom sows were observed contacting enrichments (average sows in contact: Dom, 0.119± 1.13; Sub, 0.094±1.15, P=0.006). Social status did not influence aggression scores (P>0.05). In conclusion, rotating enrichments increased sow interaction with enrichment, and overall the differences in enrichment use by Dom and Sub sows were limited.

Graduate Student Competition

Oral Session: Social behavior of pigs

Analysis of swine aggression when stable groups are moved to novel pens

Grace E. Flynn¹, Kaitlin E. Wurtz¹, Carly I. O'Malley¹, Juan P. Steibel^{1,2}, Ronald O. Bates¹, Catherine W. Ernst¹, Janice M. Siegford¹

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²Department of Fisheries and Wildlife, Michigan State University, East Lansing, USA

Recent legislative changes and consumer demands in the United States are driving a drastic shift in the US pork industry away from individual stalls for gestating sows to group-housing, in order to promote swine welfare. However, producers have encountered profit loss and management difficulty with group-housing due to the aggression pigs demonstrate to establish a dominance hierarchy. Aggression typically subsides within 24-hours, but some groups continue to fight after this initial period, causing chronic stress and reduced feed intake and growth rate. This project aimed to test the stability of established hierarchies by moving two groups (13 pigs each) of pigs who have established social rank into new pens, creating a novel environment for these pigs. Video was recorded when pigs were initially mixed into a new group, at 3-weeks post-mix, and at 6-weeks post-mix when each group was transferred to a new pen. The stability of the group was assessed by quantifying the amount of aggression occurring at each period. Aggressive behaviors were recorded using all-occurrence sampling for the first four-hours of each stage. Frequency and duration of each behavior were summed for each stage and compared using an ANOVA. Mean occurrences of aggression were 824.5, 373, and 294.5 for 24-hour post-mix, 3-week post-mix, and 6-week novel pen, respectively. The study found a difference ($P < 0.05$) between amount of aggression in the 24-hour post-mix pens versus both the 3-and-6-week post-mix pens. However, no difference was observed between the 3-week post-mix pens and 6-week novel pens. These results are beneficial to producers when transitioning to group-housing systems in the coming years because they indicate that producers can move stable groups of pigs to new pens if management practices require without fear of inciting more aggression and potential profit loss.

Undergraduate Student Competition

Oral Session: Social behavior of pigs

The relationship between social aggression and play behavior in finisher pigs: do pigs that play less fight more?

Hannah E. Pearsall¹, Alexis F. Hinson¹, Carly I. O'Malley¹, Kaitlin E. Wurtz¹, Juan P. Steibel^{1,2}, Ronald O. Bates¹, Catherine W. Ernst¹, Janice M. Siegford¹

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Studies have shown that domestic pigs, *Sus scrofa*, are an incredibly social and playful species. However, in modern production settings, unfamiliar pigs are mixed regularly resulting in a need to reestablish a social hierarchy via intense fighting. This intense aggression causes unnecessary stress and injuries which are both welfare concerns. Alternatively, play behavior is generally accepted to be an indicator of higher levels of welfare amongst a group of conspecifics. For this study, we investigated the relationship between play and aggression in group-housed pigs immediately post-mixing and 3 weeks later once dominance had been established ("stable" groups) to investigate the relationship, if any, between the two. Video was recorded for four pens for 24-hours for each time point. The video was decoded by a trained data collector for predefined locomotor play behaviors; scamper, pivot, head toss, flop and paw. Each pen contained 10-14 pigs. Duration of play behavior was summed for each individual. To quantify aggression, we counted total number of skin lesions (fresh, red marks) which was done pre-mixing, 24-hours post mixing, and 3 weeks later (stable). Lesions were categorized by body location (front, middle, rear), based on previous work relating differences in fighting behavior to body locations. A general linear mixed model compared the relationship between play and skin lesions. For stable lesions, the response variable was stable lesion scores with duration of play (in seconds) as a fixed effect and pen as a random effect. The same model was used for post-mix lesions, with pre-mix lesions added as a covariate. No relationships were found between play and post-mixed lesions in the front ($P=0.781$), middle ($P=0.568$), or rear ($P=0.833$). There were also no relationships between play and number of stable lesions in the front ($P=0.6698$) or middle ($P=0.297$). However, a relationship between play and rear lesions ($r=-0.0063$, $P=0.046$) was discovered. The results suggest that individuals being bullied (as evidenced by more rear lesions in the stable period) play less frequently and therefore potentially have decreased welfare.

Undergraduate Student Competition

Oral Session: Housing & Enrichment

Dairy cows and heifers prefer to calve in a bedded pack barn or natural forage compared to open pasture

Erika M. Edwards¹, Katy L. Proudfoot², Heather M. Dann³, Peter D. Krawczel⁴

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²The Ohio State University, Department of Preventive Veterinary Medicine, 1900 Coffey Road, Columbus, OH 43210 (proudfoot.18@osu.edu).

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The objectives were to determine dairy cows' preference for calving location when grouped and provided access to a varied environment, and to evaluate the relationship between cows' activity and preference for calving location. Multiparous Holstein cows (n=33) and nulliparous Holstein heifers (n=34) were enrolled as a dynamic group with size ranging from 21 to 1, as cows were added once weekly and removed after calving. From -21 d until after calving, cows had access to a bedded pack barn (section 1), open pasture subdivided into equal size (~0.23 hectares; sections 2 through 8), and an area of natural forage cover, where trees and tall grasses surrounding the pasture fence line provided seclusion (section 9). The bedded pack was 13.94 m². Man-made hides (n = 6) provided opportunities for seclusion in the pasture; hides were rotated among sections 3 to 8 weekly. Calving location was estimated using visual observation. Data loggers were attached to the rear fetlock 21 d prior to their expected calving date. To determine calving location preference, data were analyzed using a chi-square test in SAS. To determine the relationship between steps and calving location, linear regression was used. Twenty-three calvings (34%) occurred on the bedded pack, and 25 (37%) calvings occurred in the natural forage covered area. The remaining 19 calvings (28%) occurred in one of the 7 sections of open pasture, and of these, 3 cows calved within close proximity to the hides. There was a preference for the bedded pack barn ($P = 0.005$) and natural forage area ($P = 0.002$) for calving over the open pasture. Within sections, heifers calved in the area of natural forage more often than cows (72% vs 28%; $P = 0.03$), and cows tended to calve in the barn more often than heifers (70% vs 30%; $P = 0.06$). There was no relationship between the mean daily steps during the 21 d before calving and calving location (3512.7 ± 44 n/d (overall mean \pm SE); $P = 0.60$; $R^2 = 0.0045$). The results suggest heifers and cows seek seclusion when provided access to a covered barn and natural forage cover.

Graduate Student Competition

Oral Session: Housing & Enrichment

The effects of access to pasture, winter exercise, and modified stalls on the welfare and behaviours of dairy cows kept in tie-stalls.

Santiago Palacio¹, Steve Adam², Renée Bergeron³, Doris Pellerin⁴, Anne Marie de Passillé⁵, Jeff Rushen⁵, Derek B. Haley⁶, Trevor J. DeVries³, Elsa Vasseur¹

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With growing public concern for livestock being able to engage in more natural behaviour, and tie-stall dairies still being one of the major housing systems used around the world, producers will need to adjust their housing and management practices to allow for more natural behaviour. The objective of this study was to evaluate how minor stall modifications (re-adjusting the tie-rail position, increasing chain length, more bedding) applied to one or more rows in the farm and access to pasture during the pasture season and winter exercise affected lameness prevalence and ability to naturally rise of Holstein cows housed in tie-stalls. Twenty lactating cows/farm, on 12 farms, were assessed 4 times over one year. Visit 1 was conducted towards the end of the pasture season, visit 2, 9-30 days after modifications were applied, visit 3, towards the end of the winter, and visit 4, one year after visit 1. Stall modifications were applied to half of the study cows on each farm. Assessments consisted of stall lameness scoring and rising behaviors, as well as housing-based measures. Farms were separated on whether they provided exercise or not, and if cows within each farm were kept on modified stalls or in unmodified stalls; differences in overall ease of rising and rising behaviours (head or neck contact, knee adjustment, and delayed rising) as well as lameness were analyzed with a mixed linear model. Nine to thirty days after modifications (visit 2), 15% fewer cows were observed to be restricted in rising behaviour when housed in modified stalls compared to unmodified stalls (33 vs 48% respectively, $P < 0.05$); more specifically 31% of cows in unmodified stalls made head or neck contact with the tie-rail when rising, compared to only 19% of cows housed in modified stalls ($P < 0.05$). At the end of winter there were 20% fewer lame cows in the herds with access to winter exercise (18%) compared to herds without exercise (38%, $P < 0.05$). Results showed that both simple modifications to the stall and access to pasture and winter exercise can improve the cows' ability to more naturally rise and improve their welfare.

Graduate Student Competition

Oral Session: Housing & Enrichment

Effects of nursery space allowance on the behavior and salivary cortisol levels of weaned pigs

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Little is known about the effects of stocking density on nursery pig behavior. Therefore, the objective of this study was to determine the effects of space allowance on piglet behavior, growth and welfare. The study spanned 3 seasons and used 1200 newly weaned pigs housed at six space allowances (k values: 0.0230, 0.0265, 0.0300, 0.0335, 0.0370 and 0.0390), in groups of 10 and 40 pigs/pen. Pigs were weighed weekly and pen size was adjusted based on the predicted average body weight of pigs. Overhead cameras recorded pig behavior for 12 hours in weeks 1, 3 and 5. Time budgets for four focal piglets per group (all female) recorded the time spent feeding and drinking each week. Saliva samples were collected for cortisol analysis in weeks 1, 3, 5 and 6. Focal pig results were analysed using Proc mixed and Proc glimmix procedures in SAS (9.4) with fixed effects of density, group size and week. Density had a significant effect on feeding behaviour, with pigs at lower space allowances having more meals per day, but of shorter duration (average bout duration: $k=0.0230$, 49.1 s; $k=0.0390$, 58.6 s. SEM 1.7, $P=0.004$), and spending less time feeding overall compared to pigs at higher allowances (total feeding duration: $k=0.0230$: 44.5 ± 2.6 vs $k=0.0390$: 49.0 ± 2.9 min. LS means \pm SEM, $P=0.018$). The effect of density on drinking behavior was significant for total frequency/day and mean duration of drinking bouts ($P<0.05$), however the density response was not linear. Group size had a significant effect on feeding and drinking behavior. Pigs in groups of 10 tended to eat fewer but longer meals (average bout duration; Group=10: 53.7 ± 0.02 s; Group=40: 50.6 ± 0.02 s. LS means \pm SEM, $P=0.056$) and pigs in groups of 40 spent more time drinking with longer bouts. Salivary cortisol levels were also affected by density, with pigs at higher space allowances having higher cortisol levels, possibly as a result of higher activity levels. In conclusion, lower space allowances resulted in pigs feeding more frequently and for a shorter duration, but did not have an obvious impact on welfare.

Graduate Student Competition

Oral Session: Housing & Enrichment

It's no laughing matter: cage color and light intensity alter rat affect

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Laboratory lighting is poorly suited to rodent natural preference for low light. Some laboratories reduce light levels by using intracage shelters made of red tinted plastic. Red shelters appear opaque to rodents while allowing for visual welfare assessment by laboratory personnel. Red tinted plastics decrease light intensity and change light spectrum, which may impact rodent affect and behavior. Our purpose was to determine if manipulating lighting and caging environment effects human-rat interactions, such as tickling. Tickling reduces fear and improves welfare. When tickled, rats produce 50-kHz ultrasonic vocalizations indicative of positive affect. We hypothesized that altering cage environment by manipulating light intensity and spectrum will alter rat positive affect as measured through tickling. Four breeder rat pairs of albino *crl:CD* and pigmented *crl:Long Evans (LE)* stock were randomly assigned to either red or clear caging at either low (25 lux) or high (200 lux) light intensity. Their offspring were weaned at 3 weeks into cages of same sex pairs of one *CD* and one *LE* rat. Offspring were housed at the same cage color and light intensity as reared. The following treatments were applied in a factorial design: 2 cage colors, 2 lighting intensities, 2 strains, and 2 sexes (48 rats; n=3). Three days after weaning, rats were tickled 2 minutes daily for 7 days, and ultrasonic vocalizations were recorded. Vocalizations were coded by observers blinded to treatment. Data were analyzed using GLM with a priori contrasts. In red cages, rats produced more 50-kHz vocalizations at 200 lux than 25 lux ($F_{1,18}=0.2$; $p=0.0024$). In red cages, more 50-kHz vocalizations were produced by *CD* rats than *LE* rats ($F_{1,284}=7.0$; $p=0.0086$). In clear cages, more 50-kHz vocalizations were produced by *LE* rats than *CD* rats ($F_{1,284}=15.2$; $p=0.0001$). *CD* rats produced more 50-kHz vocalizations at 200 lux than at 25 lux ($F_{1,25}=25.3$; $p=0.0007$). Lighting intensity and cage color affect rat positive vocalizations during tickling. These results are surprising considering historical rat preference for low light. Future investigators should consider environmental lighting when conducting tickling experiments. Our results suggest that interactions between cage color, lighting intensity, and strain can influence rat behavior and human-animal interactions such as tickling.

Graduate Student Competition

Oral Session: Housing & Enrichment

Behavioral responses of Allegheny woodrats to fluctuating enrichment stimuli and their implications for reintroduction programs

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The reintroduction of extirpated species from captive populations is an important tool for the recovery of endangered species; however, behavioral deficits (e.g. lack of anti-predator and proper foraging behaviors) among released individuals limit the success of these programs. Furthermore, the development of abnormal repetitive behaviors (ARB) has the potential to limit reproductive success. Allegheny woodrats (*Neotoma magister*) are a rapidly declining species, and a captive-breeding program was designed to augment remnant populations. The goal of this study was to stimulate a broad repertoire of natural behaviors and reduce the development of ARB in captive-reared woodrats using a rotation of various types of enrichment. At weaning each woodrat (13; 7 females and 6 males) was randomly assigned to a rotation of the following treatments: food allocation (food that was buried in sand, hidden in a box, or scattered throughout the individuals' enclosure); nesting material (a cedar plank that could be shredded, crinkle paper placed in a mesh container requiring the animals to work to remove it, or facial tissue placed in the same mesh container); and running wheel (present or absent). Items within each treatment were rotated weekly. Five behavioral categories (active, inactive, maintenance, enrichment interaction, and unknown) were recorded by instantaneous scan samples every 10 minutes, 3 days each week, for 5 weeks. Time budget data was analyzed as a GLM and square root transformed for normality. ARBs were recorded at the same intervals and summed for a GLIM analysis with Poisson distribution. Behavioral patterns varied among individuals ($F_{4,11}=63.99$, $P<0.001$). Woodrats spent the most time inactive and the least performing maintenance behaviors ($P<0.05$). However, none of the enrichment treatments altered observed behavior budgets. ARB observations significantly increased when a running wheel was present compared to days when it was removed ($\chi^2=54.0$, $P<0.001$). Overall, these results suggest that the presence of a running wheel increased the display of ARBs in captive-reared woodrats, but overall the enrichments provided did not affect general time budgets.

Graduate Student Competition

Oral Session: Welfare assessment

Pekin duck welfare assessment: a comparison of methods

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Duck welfare is often assessed using the individual catch-and-inspect (CAI) approach, which requires handling of birds, and/or a modified version of the transect walks (TW) method, during which ducks are inspected as the observer walks the length of the barn. The objectives of this study were to compare Pekin duck welfare assessed using the two methods, and to evaluate of inter-observer reliability of these methods. Six flocks (5850-6300 ducks/flock) of 30-day-old ducks were evaluated (2 flocks per barn) independently by two observers using both approaches. For CAI, 150 ducks were evaluated per flock. The entire length of each pen was walked 7 times (7 transects) during TW, allowing for most birds to be observed. The same welfare indicators were scored using both methods: feather quality (featherless areas $< 5 \text{ cm}^2 = \text{FQ1}$; $> 5 \text{ cm}^2 = \text{FQ2}$), feather dirtiness (dirty areas $< 5 \text{ cm}^2 = \text{FD1}$; $> 5 \text{ cm}^2 = \text{FD2}$), blood on feathers (presence of blood = BF), eye condition (dirt or staining around the eye = E1; eyes sealed shut or blind = E2), nostril condition (nostril blocked from inside = N1; nostril opening closed = N2), and lethargic birds (crouched down and inactive = L). Frequency data were analyzed using chi-square tests in Proc Freq (SAS v.9.4). Observed frequencies of indicators were not different between transects during TW and locations during CAI within a flock ($P > 0.05$), except for BF ($P < 0.001$), suggesting that ducks with specific welfare issues were homogeneously distributed within the flock. Proc Mixed (SAS v.9.4) was used to evaluate the observer effects and the effect of the sampling method. Inter-observer reliability was high ($P > 0.05$). Higher proportions of ducks were determined to have FQ1, FQ2, FD1, FD2, BF, E1, and N1 scores using CAI than TW (all $P < 0.001$). The incidences of E2 ($P = 0.192$), N2 ($P = 0.093$), and L ($P = 0.294$) were similar. The high inter-rater reliability and efficiency of TW warrant further exploration into its utility for evaluating duck welfare. However, additional work is needed to evaluate the relative accuracy of the two methods.

Oral Session: Welfare assessment

Impacts experienced at the keel and development of keel bone damage in laying hens in enriched housing systems

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The causes of keel bone damage in laying hens housed in enriched colony cage systems is unclear. We examined whether impacts experienced at the keel bone corresponded with changes in keel bone integrity. W-36 hens were housed 60 birds per cage in 12 cages across 4 rooms (3 cages/room). Each room contained one of two types of enriched colony cages varying mainly in perch design: Cage Type A contained square plastic perches and Cage Type B contained round metal perches. Ten randomly selected hens per cage (120 total) were fitted with vests containing tri-axial accelerometers with keel-located sensors. Impacts at the keel were recorded for each focal hen during two 3-week trials at 52-61 weeks of age (Trial A) and 74-83 weeks of age (Trial B). At the start and end of each trial, hens were scanned using computerized tomography to evaluate keel damage development and type (fracture or deviation). Hens were continuously video recorded to observe behaviors associated with impact events. Of the 14,516 keel impacts recorded, 52.37% had a combined peak acceleration magnitude of 16-20G, 20-40G: 22.27%, 40-60G: 9.3%, 60-80G: 4.94%, 80-100G: 3.03%, and 7.99% were greater than 100G. More than half (54.32%) of the hens experienced new fractures and 32.1% experienced new deviations during Trial A; 41% and 20% respectively during Trial B. Collisions with perches were identified as the main cause of impacts. Cage Type A had significantly more collisions than Cage Type B ($P < 0.001$), and 61.7% of all overall impacts occurred in Cage Type A. There was a trend between the number of collisions $>20G$ and the presence of new damage ($P = 0.054$), however the development of keel damage did not vary between cage types ($X^2 = 3.88$, $P = 0.27$). In conclusion, we found a high overall incidence and development of keel damage (particularly fractures) and evidence that hens are experiencing high level keel impacts in enriched cage systems. Cage differences and behavior analysis suggest perch type as a possible risk factor for collisions. Further work should be directed at understanding whether cage modifications can mitigate the occurrence of keel bone damage by reducing collision events.

Graduate Student Competition

Oral Session: Welfare assessment

Examining the efficacies of two non-penetrating captive bolt devices for the on-farm euthanasia of broiler breeders

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On-farm euthanasia is a common practice and crucial part of any animal welfare program. Although methods of euthanasia vary widely between farms, any technique used should result in rapid, irreversible loss of sensibility while minimizing distress to the animal. However, there is very little data on euthanasia methods, particularly for poultry. This study assessed the efficacies of two non-penetrating captive bolt devices, the TED[®] and Zephyr-EXL[®], for on-farm euthanasia of cull broiler breeders, where the TED[®] is a gas-powered device and the Zephyr-EXL[®] is pneumatically powered. To achieve this, focal trials were conducted on 100 roosters, 100 hens and 100 pullets collectively from four broiler breeder farms across Ontario. Stockpeople were trained with the devices prior to performing the procedures. Measures of sensibility including nictitating membrane reflex, pupillary light reflex, duration of clonic and tonic convulsions, time to cloacal relaxation and time to cessation of convulsions were recorded for every bird by trained researchers. Once convulsions had ceased, the birds were assessed and scored for damage caused by the device on a 3 point scale, where 0 was no external bleeding and 2 was extensive blood loss at the device application site. A general linear model was used to compare the device, age and sex effects, along with their interactions, with Tukey tests run post-hoc. The results showed the TED[®] and the Zephyr-EXL[®] caused immediate loss of sensibility 96.7% and 97.3% of the time, respectively. Time to cessation of convulsions differed between sexes ($P=0.0042$) and ages ($P<0.001$); mature female birds ceased convulsions sooner ($170.7 \pm 7.5s$) than any of the males ($236.0 \pm 6.5s$) and younger females ($280.4 \pm 10.6s$). Cloacal relaxation was observed to be the last reflex before complete cessation of movements in 266 birds, suggesting it could be a conservative indicator of time of death. The Zephyr-EXL[®] caused significantly more damage than the TED[®] ($P<0.0001$), at the site of application (1.4 for the TED[®]; 1.8 for the Zephyr-EXL[®]). In conclusion, both devices induced immediate loss of sensibility by directly disrupting brain functions and thus effectively providing a humane death.

Graduate Student Competition

Oral Session: Welfare assessment

Aversion to argon-induced hypoxia in pigs using approach-avoidance and conditioned place avoidance paradigms

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The objectives of this study were to assess weaned pigs aversion to argon-induced hypoxia during i) proximate exposure and ii) loss of consciousness (LOC) using approach-avoidance and conditioned place avoidance paradigms. We hypothesized pigs would display avoidance at the lowest O₂, and conditioned place avoidance would be observed on the washout days (day following gas day) that followed LOC. A preference-testing device with 2 identical chambers separated by a sliding door and an exhaust sink was utilized. Twelve crossbred gilts (4.4±0.2kg) were trained for 5d to enter the treatment chamber (TC) after the sliding door was opened. A food reward was offered and pigs had 10 min to move freely between chambers. The same methods were used during the testing phase with O₂ treatments in TC maintained at one of two concentrations: 6% or 2%. Tests concluded when LOC occurred or after 10 min. Pigs experienced each of the O₂ treatments on gas day (G), preceded by ambient conditions on one baseline day (B) and on one washout day (W) during 2 rounds. Tests concluded when LOC occurred or after 10 min. Behavior was collected using live observations and video recordings. Aversion outcomes included latencies to enter, leave, and re-enter TC. Data were analyzed using PROC GLIMMIX of SAS. All pigs entered TC on all days. No significant day or gas treatment effects were observed for latency to enter TC, but pigs left TC faster on G than B and W days (mean±SE: 153.4±15.6s, 382.6±34.2s and 366.3±34.4s; *P*<0.01). On G days, pigs left TC faster at 2% than at 6% O₂ (95.5±22.3s, 187.7±32.4s; *P*=0.03). On G days, pigs took longer to re-enter TC than on B and W days (53.6±15.8s, 18.6±4.9s, 22.0±6.3s; *P*=0.03), but gas treatment did not differ. Six of the twelve pigs at 2% O₂ showed LOC in 156.8±35.3s but none at 6% O₂. Carryover treatment effects were not evident on any washout days. In conclusion, hypoxia at both O₂ concentrations was aversive to pigs compared to ambient conditions, however the relative degree of proximate aversion did not provoke avoidance behavior and conditioned place avoidance was not observed.

Graduate Student Competition

Oral Session: Welfare assessment

Associations between tail lesions and other injurious behaviours and health deviations in pigs

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Tail lesions are indicative of tail biting behaviour and impaired welfare in pigs. They have been suggested as possible 'iceberg' indicators meaning that could serve to provide a picture of the overall health and welfare of pigs and function as a warning signal for other welfare problems. This work is part of a study which aimed to validate tail lesions on the carcass as possible iceberg indicators. Thirty-one farrow-to-finish Irish pig farms were visited and pigs in randomly selected pens of first (n=6) and second (n=6) weaner stage and finisher stage (n=6) were observed. Pigs were observed for 10 min per pen and during this time the number of pigs with tail, ear, flank and skin lesions and those showing signs of other health deviations (e.g. lameness, sickness, hernia) were recorded. Frequency of coughing and sneezing (5 min) and tail-, ear-, and flank biting, fighting and mounting behaviour (5 min) was recorded by all occurrence behaviour sampling. Welfare outcomes were expressed as percentage of pigs in a pen affected and behaviours were expressed per pig to correct for different numbers of pigs per pen (31.4±17.7 pigs/pen). The effect of welfare outcomes and behaviours on the percentage of pigs with tail lesions were analysed using mixed model equation methods. Farm and production stage were included as fixed effects and welfare and behaviour indicators were included as covariates. Pen within production stage by farm was included as random effect. On average, 7.5±0.62% of pigs in a pen had tail lesions of which 1.1±0.83% was considered as severe lesions (i.e. blood visible). Percentage of pigs with tail lesions was greater when there was a higher percentage of pigs with skin lesions (P<0.05). Furthermore, the percentage of pigs with tail lesions was positively associated with tail (P<0.001) and ear biting (P<0.05). In contrast, in pens with a higher percentage of sick pigs (P<0.01) or pigs with hernias (P<0.05) there was a lower percentage of pigs with tail lesions. Results suggest that tail lesions can inform about the welfare status of pig which is not necessarily limited to tail biting but can also include the occurrence of other damaging behaviours, but also pig health supporting their role as iceberg indicators.

Oral Session: Welfare assessment

The effect of 24 hour lying and sleep deprivation on energy balance, behavior, and milk yield

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The objective was to determine the effects of sleep or lying deprivation on the behavior and productivity of dairy cows. Data were collected from 8 multi- and 4 primi-parous cows (DIM = 199 ± 44 (mean ± SD); days pregnant = 77 ± 30). Each cow experienced two treatments: 1) 24 h sleep deprivation and 2) 24 h lying deprivation. Each observation period lasted 11-d (from 2 d before the treatment (trt) to 8 d after trt), and was followed by 12-d washout period before the next treatment period. During habituation (d -2 and -1 relative to trt), baseline (d 0), and trt (d 1), cows were housed in individual stalls (mattress without bedding). After trt, cows returned to sand-bedded freestalls for a 7-d recovery period (d 2 to 8). Lying behaviors were recorded by accelerometers attached to the hind leg. Milk yield was recorded 2×daily. NEFA and glucose concentrations were evaluated from serum sampled at 0300, 0900, 1500, and 2100 on d 1 and 2. Data were analyzed using a mixed model in SAS including fixed effects of trt, day, and their interaction; pairwise comparisons were made using the PDIFF statement. Lying time was higher on the first day of recovery after lying deprivation compared to sleep deprivation (d 0 lying deprivation: 8.78 ± 0.65 h/d; d 0 sleep deprivation: 8.63 ± 0.66 h/d; d 2: 16.8 vs. 13.6 ± 0.7 h/d; $P = 0.002$). Milk yield was lower during lying deprivation compared to sleep deprivation on d 2 (31.8 ± vs. 35.3 ± 2.4 kg/d; $P = 0.002$). NEFA and glucose were not affected by trt ($P \geq 0.70$), but did vary by time ($P \leq 0.03$). The combination of sustained energy balance with decreased productivity suggest cows may shift resources towards increased maintenance during lying deprivation. Collectively, results suggest that lying time is important to dairy cows, as they will spend more time lying after a period of deprivation, and a short period of lying deprivation can impact milk yield.

Graduate Student Competition

Oral Session: Health & Pain relief

Relationship between the clinical and behavioral response to a mastitis challenge with *Streptococcus uberis* from Holstein dairy cows

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Treatment of mastitis may be improved by earlier detection through use of sickness behaviors. The objective was to determine the relationship between clinical signs of mastitis, induced by a *Streptococcus uberis* challenge, and resting behavior of early lactation dairy cows. Holstein cows in their second (n=21) and third (n=7) lactation were enrolled and intramammary challenges were conducted with *S. uberis* ($10,560 \pm 1,855$ CFU) within 1.2 ± 0.7 days after calving. Milk samples, milk score (MS), and udder inflammation score (US) were collected on d -1, every 12 h on d 0-3, and daily on d 4-7 relative to challenge. MS and US were assessed from appearance of the milk and udder, respectively, with a score of 0 = normal and 3 = severe. Milk samples were used to determine somatic cell count (SCC). Accelerometers attached to the hind leg recorded lying duration (h/d) (LD) and mean bout duration (min/bout) (BD). Data were summarized by 24-h period beginning at 0900 h using the means from days in which more than one score was recorded. Data were analyzed using a regression model in SAS (v9.4) to determine the relationship between the independent variables of SCC, MS, and US and the dependent variables of LD and BD. MS was positively associated with BD ($P = 0.005$; $R^2 = 0.04$; $y = 6.4x + 72.6$), but SCC ($P = 0.74$) and US ($P = 0.26$) were not. SCC ($P = 0.74$), MS ($P = 0.73$), and US ($P = 0.94$) were not associated with LD. Of the two behavior measures, BD was the most sensitive to severity measures and offers the greatest potential to predict clinical mastitis caused by *S. uberis*. The positive relationship between MS and BD most likely reflects the strength and systemic progression of the acute inflammatory response. Closer examination of the timing of these events relative to each other may provide additional insight to using resting behavior to predict future cases of clinical mastitis.

Graduate Student Competition

Oral Session: Health & Pain relief

Behavioral changes in group-housed dairy calves infected with *Mannheimia haemolytica*

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Insight into sickness behavior may be the means to improving identification, management, and welfare of sick animals. The objective of this study was to identify components of sickness behavior in group-housed Holstein dairy calves infected with *Mannheimia haemolytica* (MH). Calves (aged 3-7 weeks; 58.0 ± 12.0 kg BW) were group-housed based on age and BW in sand-bedded pens (6 calves/pen, 6.6 m²/calf) and provided pasteurized waste milk (8 L/d) 2x/d. Within group, calves were randomly assigned to treatment. On d 0, treatment calves (MH; n=12, 3/pen) were inoculated at the tracheal bifurcation with 3 × 10⁹ cfu of MH suspended in 5 ml of phosphate buffered saline (PBS) followed by a 120 ml wash PBS. Control calves (n=12, 3/pen) were inoculated with 5 ml + 120 ml of PBS. Behavioral and health data were collected for 12 h following the challenge. Each calf was fitted with an accelerometer to record standing time and lying laterality. Feeding time and frequency of non-nutritive visits to the teat were recorded from video. Rectal temperatures were obtained at 12 h post-inoculation. Activity and temperature data were analyzed in a general linear mixed model and feeding time were analyzed using the Mann–Whitney U test. Temperature differed at 12 h post-inoculation (40.1 vs 39.1 °C; MH vs. Control; SE = 0.14, P < 0.001). MH calves stood less (244.6 vs 333.3 min/d; SE = 19.7, P = 0.023) and tended to spend more time lying on their left than right (680.3 vs. 519.6 min/d; SE = 64.2, P = 0.084), with control calves expressing no lateral preference (P = 0.93). At the evening meal post-inoculation, MH calves fed for less time (1.3 ± 3.3 vs. 10.2 ± 4.7 min; mean ± SD; P < 0.001) and also had fewer non-nutritive visits to the teat (0.01 ± 0.04 vs. 1.23 ± 1.20 visits/h; mean ± SD; P < 0.001). These results show that this challenge model resulted in calves experiencing a mild disease state. Reduced feeding time, standing time, and lying laterality may be useful indicators of early stages of disease.

Graduate Student Competition

Oral Session: Health & Pain relief

The pain responses of piglets after castration when using three different analgesics: Results from a behavioural test

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Castration is a procedure that is known to be painful, however, pain responses following the procedure are difficult to quantify in piglets. This study measured piglet behaviour in a handling chute to compare three analgesics on their effectiveness for providing pain relief following castration. Newborn piglets weighing $\geq 1.00 \pm 0.05$ kg were randomly assigned to one of five treatments: 1) Castration with meloxicam (Metacam[®] 0.4 mg/kg, CAM); 2) Castration with ketoprofen (Anafen[®] 3 mg/kg, CAA); 3) Castration with paracetamol (Pracetam[®] 60 mg/kg, CAP); 4) Castration control, no analgesic given (CA); and 5) Sham castration (handling piglet as if castrating without castrating, SCA). Piglets were teeth clipped within 24 hours of birth, and no additional procedures were performed until after completion of the trial. One day prior to treatment, piglets were trained to navigate a handling chute that has previously distinguished pain responses in piglets. On treatment day, immediately prior to castration, ketoprofen and meloxicam were administered intramuscularly and paracetamol was administered orally. The navigation time (NT) of piglets (in seconds) was recorded in chute runs at 15, 40, 60, and 120 minutes post-treatment, with longer NTs being considered an indication of greater pain in piglets. Differences in the NT were analyzed using Proc Mixed (SAS 9.3) with main effects of treatment and litter and chute run as a repeated measure. Across treatments, the mean NT of CAA (13.1 ± 2.5 s) piglets was shorter than SCA (24.1 ± 2.5 s), CA (22.4 ± 2.6 s), and CAP (20.0 ± 2.5 s) by 46%, 41%, and 34% respectively ($P < 0.05$). There was a tendency for the mean NT of CAA to be 29% shorter than CAM (18.5 ± 2.5 s; $P = 0.056$). The NT of CAM piglets was shorter than SCA piglets by 23% ($P < 0.05$), with no other differences between treatments. The reduced NT of CAA and CAM compared to CA treatments indicates a potential positive effect of ketoprofen and meloxicam to reduce pain-related behaviours in piglets. The greater NT of SCA piglets compared to CA piglets is unexplained. It may indicate stressed piglets and highlights a concern with reliability of this behavioural test to assess pain.

Graduate Student Competition

Oral Session: Health & Pain relief**Clinical trial of local anesthetic protocols for acute pain associated with caustic paste disbudding in dairy calves**

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Caustic paste disbudding is becoming more commonplace in North America, but few studies have evaluated pain control for this procedure. Our objective was to evaluate the effects of either a cornual nerve block or a topical anesthetic incorporated into caustic paste on acute pain. Seventy-two calves were enrolled into 18 replicates and assigned to one of four treatments: sham (**S**), a placebo paste and a saline cornual block; topical (**T**), a novel caustic paste containing lidocaine and prilocaine, and a saline cornual block; cornual block (**B**), commercial caustic paste and a lidocaine cornual nerve block; and positive (**P**), commercial caustic paste and a saline cornual block. All calves received 0.5 mg/kg meloxicam subcutaneously. Researchers were blinded to treatment group. Primary outcomes were validated pain behaviors (head shake, head rub, and tail swish; at 15, 30, 45, 60, 90, 120, and 180-minutes post-disbudding) and pain sensitivity by algometry (60, 120, and 180-minutes post-disbudding). Secondary outcomes consisted of respiratory and heart rate, latency to approach, play behavior, feeding behavior, and standing and lying bout characteristics. Data were analyzed using linear, Poisson, and negative binomial regression models with repeated measures. A significant treatment by time interaction was present for all repeated outcomes; single level models for each time-point were therefore used. Cornual-blocked calves had less pain sensitivity at all time points after disbudding than other groups ($P < 0.001$); T and P calves had more pain sensitivity than S calves for the same time period ($P < 0.001$). Compared to T and P calves, B and S calves had fewer pain behaviors at 15, 30, 45, 60, and 90-minutes post-disbudding ($P < 0.05$), and decreased respiratory and heart rates ($P < 0.01$). S calves played more ($P < 0.001$), and had a shorter latency to feed than T or P calves ($P < 0.10$). Caustic paste appears to be acutely painful for at least 180 minutes, and this is reduced by a cornual nerve block but not by our novel paste. We recommend that calves disbudded with caustic paste receive local anesthetic by a cornual nerve block to mitigate acute pain.

Graduate Student Competition

Oral Session: Behavioral variability**Genome wide association analyses of lesion scores in group-housed swine**

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Pigs housed in groups are often regrouped with unfamiliar individuals which can trigger aggressive interactions, thus compromising their welfare. Evidence shows skin lesions (fresh, bright red cuts) are reliable indicators of aggression, and are moderately heritable, suggesting that selective breeding may reduce aggression. To further understand the biological mechanisms underlying behaviors such as the aggressive response to regrouping, associated single nucleotide polymorphisms (SNP) can be identified within the genome, and the region in which these SNP are located can be related to known genes. To investigate SNP associated with aggression, 1,079 purebred Yorkshire pigs were strategically remixed into new groups of familiar and unfamiliar animals at 3 life stages (weaning, grow-finish, mature gilts). Skin lesions were counted immediately prior to mix and 24 hours post mix across 3 body regions: front, middle, and rear. Blood samples were obtained from each individual for DNA extraction. Genotyping was performed using a 70k SNP chip (Neogen Corporation – GeneSeek Operations). Genomic best linear unbiased prediction (GBLUP) models were fit for each stage and each location with fixed effects of sex, replicate, lesion-scorer, weight and pre-mix lesions as covariates, and random effects of pen and genetic additive effect. Post-mix lesions were the response variable. The genetic additive effect was obtained from a genetic relationship matrix which was constructed using standardized genotypes from the 52,925 SNP which remained after data cleaning. SNP effects and their variances were estimated from the GBLUP objects. SNP that were associated with a significant portion of the trait variance were identified for lesions to the front (3 SNP, FDR<5%) and middle (5 SNP, FDR<10%) portions of the body in grow-finish pigs. These SNP were located on chromosome 11 for front lesions, and chromosomes 11 (same 3 SNP identified for front lesions), 3, and 8 for middle lesions. These results suggest that chromosome 11 appears to contain a region explaining variation in lesion scores and further exploration should be conducted for known genes within this region that could shed light on the underlying biological control of aggression. If genes are identified, alternative therapies for reducing aggression in group-housed pigs could be identified.

Graduate Student Competition

Oral Session: Behavioral variability**Consistency over time of individual activity budgets by gestating sows housed in ESF pens****Kristina M. Horback***, **Ilana Yablonovich**, **Thomas D. Parsons**

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A better understanding of behavioral patterns of loose housed sows promises to improve their husbandry and management. In this study, the consistency of individual activity budgets among group housed gestating sow was examined. Pregnant PIC 1050 sows housed in a dynamic group were observed for two 24 periods at a 7 day interval. The pen provided 2.4m² per sow and included several concrete lying beds, 2 deep bedded straw pits and 2 electronic sow feeding (ESF) stations which opened at midnight. Scan sampling of the behavior and location of 106 sows was recorded every 10 minutes for 24 hours, and repeated 1 week later. As a population, sows were most alert (awake/oriented to surroundings) from 0300 to 1100 and transitioned to not alert between 1300 and 0130. Individual sow location and sow behavior was highly variable between individual animals (coefficients of variation ranged between 0.5 and 1), however, individual animal location and behavior was very consistent between days (Pearson's r). The proportion of time spent at different locations (drinker, feeder, slat, straw and concrete; all P<0.001) and engaged in different behaviors (alert, move, root, sham chew; all P< 0.03) by individual sows was correlated between the two days of observation. In order to explain individual differences between animals, sows were stratified into early (0-40 day), mid-(41-85), and late (86-114) pregnancy. Significant differences were assessed via one-way ANOVA with post hoc Games-Howell tests. Early and mid-pregnancy sows walked more often (P<0.05) than late pregnancy sows. Mid-pregnancy sows spent (P=0.001) more time on concrete beds than early pregnancy sows. Early pregnancy sows spent more time in straw pits than both mid-(P=0.02) and late pregnancy sows (P= 0.003). These sows were mixed into pen directly after breeding and thus stage of gestation was also a proxy for length of residency in the pen. In conclusion, individual sow location and behavior in a large dynamic ESF pen was consistent over a 7 day time horizon and was in part explained by stage of gestation or residency in the pen. Such knowledge of individual animal differences will contribute to improved individual care and welfare of loose housed sows.

ABSTRACTS FOR POSTERS

Poster 1**Characterizing standing behavior at social grouping in weaned dairy calves****Kelsey C. Horvath and Emily K. Miller-Cushon**

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After weaning, dairy calves are commonly exposed to changing social environments, which are likely to influence behavioral development. We examined the standing behavior of recently weaned dairy calves upon introduction to a social group. Holstein heifer calves ($n = 26$) were individually housed and provided milk (10L/d) for 6 wk, and gradually weaned over 9d. Calves were then introduced to group housing on pasture (15.24 x 45.72 m) in weekly cohorts (5 ± 3 new calves/wk) at 60 ± 5 d of age. The group (8 ± 2 calves) always consisted of newly introduced calves and calves introduced the previous week. Calves were equipped with electronic data loggers (HOBO Pendant G data logger, Onset computer corp., Pocasset, MA) to measure daily standing time and standing bout frequency for a 2 wk observation period: the first wk following grouping, and the second wk, which began with addition of younger calves and removal of older calves. The effects of week and day on daily standing time and standing bout frequency were analyzed in a double repeated measures general linear mixed model. Additionally, standing time was summarized by hour to assess diurnal standing patterns. Standing data were subject to a week by day interaction ($P < 0.003$), with a peak on the day of introduction for standing time (527.91 vs 427.47 min/d; d 1 of wk 1 vs. d 1 of wk 2; SE=24.97; $P=0.0046$) and standing bouts (20.48 vs 13.55 bouts; SE=1.35; $P=0.0006$) but decreasing standing over wk 1 and stable standing duration during wk 2. On the day of introduction, there was a week by hour interaction for standing time ($P < 0.0001$) with newly introduced calves standing longer immediately after introduction, but spending less time standing later in the day relative to behavior after 1 wk. These results suggest that the first few days of introduction to a social group have a marked influence on standing patterns, but that previously grouped calves are less responsive to the addition of new calves into the group.

Graduate Student Competition

Poster 2**Evaluation of single vs. paired calf housing on behavior and immunity of Holstein calves: A proposal****Clay B. Kesterson, Peter D. Krawczel, Gina M. Pighetti**

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Pair housing dairy calves improves feeding behaviors, and body weight following weaning. The effects of behavior, such as sleep, sensitivity to dehorning based on social housing, and immunopathology that may contribute to these benefits are unestablished. Our objective is to determine the effect of pair versus individual housing calves on sleep and resting behavior, pain sensitivity to dehorning, and immunity. Calves with successful passive transfer of immunoglobulins from colostrum (STP reading ≥ 5 g/dL) will be blocked by sex and birth date and enrolled into pair (n = 24) or individual (n = 12) housing. Milk replacer (protein 26: fat 20) will be fed twice daily (3L/feeding), with ad libitum grain and water. On d 5, calf pairing will be implemented by combining two individual pens. One paired calf will be used for data collection. Control calves will remain individually housed. Pair calves' lying proximity to one another and posture in both treatments will be evaluated by scan sampling video data over 4-d increments on d 16 and 42. Lying time, bouts, and laterality will be assessed by accelerometer. Electrophysiological data will be recorded for 24 hours on d 16 and 42 to evaluate sleep. Calves will be inoculated with xylazine (0.15 mL) and lidocaine (12 mL) before hot-iron dehorning (d 35). Pain sensitivity will be measured by pressure algometry -1, 3, 27, 51, and 75 hours, relative to dehorning. Four locations surrounding the dehorning sites will be evaluated. Calves will be inoculated with keyhole limpet hemocyanin (KLH) on d 7 to evaluate humoral immunity. A combined injection of KLH and heat-killed *Candida albicans* will be given on d 21 followed by antibody evaluations on d 14, 28, and 35. Cell mediated immunity will be tested with intradermal injections of *C. albicans* on d 28. Skinfold thickness tests will measure delayed- hypersensitivity at 0, 6, 24, and 48 hours after intradermal injections. Performance will be assessed by measuring feed intake over 3 days, and weekly growth rates until weaning. We anticipate pair housing will improve quality of sleep, resting behaviors, ability to cope with dehorning, acquired immune development, and growth of calves.

Graduate Student Competition

Poster 3

Sows' preferences for different fresh and dry mixed forages

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The aim of this study was to determine sows' preferences for different forage mixtures used in Canada. Four forage mixtures, composed of different proportions and species of legume [alfalfa (Alf) or clover (Clo)] and grass [tall fescue (F) and/or timothy (T)], were compared when offered either fresh or as hay. The proportions of legume in fresh forages and hays were, respectively: AlfF=31 and 40%; CloF=36 and 31%; AlfT=55 and 61%; and CloT=77 and 77%. Over 6 consecutive days, all 6 combinations of two forage mixtures were offered (one combination per day) during 45 min to eight second-parity gestating sows housed in individual pens and fed a concentrate for 100% of their requirements. Fresh and dry forages were tested on different sows. Voluntary intake was measured for each sow and each forage. For each pair proposed, difference in intake between the two forages offered was determined using a Student's t-test, and the most ingested forage was considered as the preferred one. Preference ratio was calculated by subtracting the amount of the least preferred forage from the most preferred forage and dividing by the sum of the two intakes. Results revealed clear preferences for some mixtures. When served fresh, AlfT and CloT forages were preferred over AlfF and CloF ($P<0.05$) with preference ratios varying from 0.40 to 0.87. When served as hay, AlfT was preferred over AlfF and CloF; and CloT was preferred over CloF ($P<0.05$) with preference ratios varying from 0.44 to 0.75. Therefore, it seems that forage mixtures with a greater proportion of legume (AlfT and CloT) were preferred over forage mixtures with a higher proportion of grass (AlfF and CloF). AlfF and CloF contained at least 30% of tall fescue and, therefore, the preference for AlfT and CloT could also be due to the absence of tall fescue. In previous studies, legumes were often preferred over grasses by sows, thus the preferences observed in this study are most likely due to the greater proportion of legume. Our results suggest that forage mixtures with high proportion of legume are preferable to maximise both fresh and dry forage intake in sows.

Graduate Student Competition

Poster 4**It's getting hot in here: A preliminary study to evaluate the impact of *in utero* heat stress on piglet behavior after weaning and transport****Christopher J. Byrd¹, Nichole M. Chapel¹, Drew W. Lugar¹, Matthew C. Lucy², Timothy J. Safranski², Jay S. Johnson⁶**

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The postnatal effects of *in utero* heat stress (IUHS) on offspring behavior following normal production stressors are unknown. Therefore, the study objective was to characterize IUHS offspring behavior after weaning and transport. On d 30 of gestation, pregnant first parity gilts were exposed to either thermoneutral [TN; n = 6; 17.8 ± 0.1°C; 61.4 ± 0.1% relative humidity (RH)] or heat stress (HS; n = 6; cycling 28 to 38°C; 71.1 ± 0.2% RH) conditions for 30 d before returning all pregnant gilts to TN conditions until farrowing. At weaning (d 21 postnatal life), 20 piglets were randomly selected from each treatment group (n = 4 IUHS boars, 8 IUHS barrows, 4 IUTN boars, 4 IUTN barrows) and then transported 8 h from Columbia, MO to West Lafayette, IN. Upon arrival, piglets were pair-housed by treatment and sexual status. Piglet behavior was monitored daily for 3 d post-transport. Over a 4 h period (1000-1400 h), scan samples were collected in 2 min intervals to evaluate posture (lying, standing), while huddling, aggression, and straw manipulation behaviors were sampled using continuous observation. Data were analyzed using repeated measure mixed model ANOVA in SAS 9.4. No overall treatment differences were observed for posture, huddling or straw manipulation behaviors (P > 0.25). *In utero* HS pigs spent less time performing aggressive behaviors than IUTN pigs (0.36 ± 0.02% vs. 0.95 ± 0.02%; P = 0.04). Boars were more aggressive than barrows (1.31 ± 0.02% vs. 0.19 ± 0.01%; P < 0.01), regardless of *in utero* treatment. Day was associated with huddling behavior (P = 0.02) and posture (P < 0.01). Huddling behavior increased on d 3 compared to d 2 (51.4 ± 6.7% vs. 30.8 ± 6.3%; P = 0.01). Lying increased between d 1 and d 2 (25.5 ± 6.8% vs. 43.3 ± 6.0%; P = 0.02) and decreased between d 2 and d 3 (23.0 ± 5.7%; P < 0.01). In summary, these preliminary data demonstrate an effect of IUHS on aggressive behavior following weaning and transport stress; however, a longer observation period may be needed to support this conclusion.

Graduate Student Competition

Poster 5**Effects of probiotics on anxiety-like behavior in weaned pigs****Morgan B. Garvey¹, Elizabeth Petrosus², Jeremy N. Marchant-Forde², Susan D. Eicher²**¹Department of Animal Sciences, Purdue University West Lafayette, IN (garvey1@purdue.edu)²United States Department of Agriculture, Livestock Behavior Unit, West Lafayette, IN (epetrosu@purdue.edu, jeremy.marchant-forde@ars.usda.gov, susan.eicher@ars.usda.gov)

At weaning pigs face many physiological, social, and environmental challenges which can result in reduced pig health, growth, feed intake and in the worst-case death, especially within the first week. The objective of this study was to reduce stress at weaning through the use of probiotics, shown to have anxiolytic effects in other species. Sixteen pens of 5 male piglets were selected for this study and randomly assigned to probiotic and control treatments. Piglets were administered one dose of either 1mL of chocolate milk alone or with probiotics 5 d/wk, from within 24 h of birth, until 25 d of age. Pen was the experimental unit (n = 8 pens/treatment). One piglet from each pen was selected at 14 d and another at 18 d of age and subjected to two different behavior tests during the study; an isolation box used to investigate the piglets' responses to social isolation and a holeboard test used to evaluate piglets' investigative behaviors when placed in a novel environment. Vocalizations were recorded and categorized as either grunts, squeals, or vocalizations (grunts and squeals) for each test and analyzed using repeated measures in Mixed Models in SAS with fixed effects of treatment and age with their interactions. Vocalizations of probiotic pigs were fewer ($P_{\text{treatment*age}} = 0.02$) on d 18 than controls, but similar on d 14; d14 (428; 504) and d18 (443; 306) for control and probiotic pigs. This suggests probiotic pigs experienced less anxiety as they got older. Time effects (534.88 vs. 309.50 - isolation box and 407.69 vs. 301.36 - holeboard test, $P < 0.05$) were detected for grunts in both tests from day 14 to day 18. Grunts in pigs can indicate exploration or seeking social contact. The decrease in frequency of grunting as probiotic pigs aged could indicate that they were not seeking social contact as they got older and were more comfortable in an unfamiliar setting as a result of probiotic administration. Squeal results were not significant. These data suggest that a minimum of 14 d of probiotic administration is necessary for a reduction in vocalizations associated with stressors to be detected.

Graduate Student Competition

Poster 6**An aural-visual classification of the vocal repertoire of adult pigs (*Sus scrofa domestica*)****Kathryn Y. Henley, Je’Vana L. Pickens, Betty Pat, Virginia Aida, Candace L. Floyd**

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Due to their numerous anatomical and physiological similarities to humans, the use of pigs in scientific disciplines such as clinical education and biomedical research is increasing. A broader understanding of their behaviors in this environment is warranted to inform welfare practices and experimental protocols. Pigs are social animals that communicate using vocalizations, thus analysis of vocalizations may provide a noninvasive way to assess health and affective status. However, the vocalization repertoire of adult pigs has yet to be characterized. The purpose of this study was to describe the vocal repertoire of adult pigs in a biomedical research laboratory. Twelve adult (2-3 months old) male (n=5) and female (n=7) mixed-breed pigs were recorded during routine husbandry and study-related procedures in a biomedical research laboratory over two weeks. Investigators actively recorded the animals using a BeyerDynamic Hypercardioid microphone and GoPro® Hero2 camera at a sampling rate of 48 kHz and 16-bit sample size. Spectrograms were generated from .wav audio files using Raven Pro 1.5 (Cornell Laboratory of Ornithology) with a 2048-point discrete Fourier transform (DFT), Hann window (23.4 Hz resolution) and 50% overlap. Each spectrogram was coded and assessed in a random order. Vocalizations were identified and classified based on aural and visual characteristics by an investigator naive to the recording condition. A total of 1528 vocalizations from 81 recordings were analyzed. Aural-visual classification revealed a hierarchical acoustic structure including four vocal classes: grunt, bark, squeal, and scream. Grunts comprised 77% of vocalizations and were further divided into four subclasses: classic, growls, croaks, and complex. Squeals comprised 13% of vocalizations and were further divided into three subclasses: classic, whines, and yelps. Screams and barks (7% and 2% of vocalizations, respectively) both were divided into classic and complex subclasses. We found that the grunt vocal class was the most common vocalization. The resulting vocal repertoire will lay the foundation for welfare assessment and comparative analysis in adult pigs in research laboratories. This work was supported in part by the Department of Veterans Affairs, Veterans Health Administration, Office of Research and Development, Rehabilitation Research and Development Service (121RX002200).

Graduate Student Competition

Poster 7**Do different behavior tests measure similar personality dimensions in domestic pigs?**

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There is growing interest in using the concept of animal personality to study the behavior and fitness of animals within a population, both in natural and captive settings. Among gregarious species, the mix of personality types within a population can have profound effects on individual and group fitness. In this study, we investigated whether pigs showed consistent responses across multiple situations that could be indicative of personality. Behavioral tests have been used to assess primary personality traits such as extraversion, neuroticism, and agreeableness. Pigs' responses to three behavior tests (human approach (HAT), handling, and novel object (NOT)) were compared for 257 purebred Yorkshire barrows, across 20 pens of 12-15 pigs, in the grow-finish phase to measure the pigs on these personality dimensions. HAT was conducted at 14-wk old in the home pen by all-occurrence scans every 30-s for 9-mins. Frequency and intensity (low/moderate or extreme force) of oronasal contact with the observer was recorded. The handling test was also conducted at 14-wk old. Activity and reactivity while entering, in, and leaving a weigh crate were recorded. The NOT was conducted at 17-wk old. Individual pigs were moved to an arena, given a 1-min acclimation period followed by a 9-min exposure to a basketball. Pigs were scored for their latency to approach within 1-meter of the ball, 0.5-meter of the ball, and to touch the ball. They were also scored on number of times they crossed the 1-meter and 0.5-meter line, and number of times they touched the ball. Mantel tests were used to compare responses between the tests. There were no significant relationships between variables of the different tests: latency to novel object (NO) and HAT ($r=-0.043$, $P=0.965$); number of times approaching and touching NO with HAT ($r=-0.008$, $P=0.618$); latency to NO and handling scores ($r=-0.009$, $P=0.594$), number approaches and touches of NO with handling scores ($r=-0.027$, $P=0.806$); HAT and handling scores ($r=0.014$, $P=0.26$). The results of this study suggest that that these behavior tests are measuring different personality dimensions, and these dimensions are not related to each other.

Graduate Student Competition

Poster 8**Comparison of perching behavior and its effects on keel bone deviations of laying hens in two types of enriched colony cages**

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We examined the hypothesis that prolonged perching may contribute to the development of keel bone damage. In this study, 60 Hy-Line W-36 hens were housed in each of 12 enriched colony cage systems with access to square PVC perches or round metal perches (6 cage replicates per perch type). Two hens per cage (24 hens total) were observed: one that developed a deviation of the keel bone over the course of the trial, and one that did not (control). Deviations were diagnosed based on 3D models created from CT scans taken at the beginning and end of 21-day trials, which took place when the hens were between 52-60 weeks old. The hens were observed on two evenly distributed days within each 21-day trial. Continuous observations were made three times a day in two-hour blocks (morning, midday, and evening). Perching occurrence (both feet on the perch for > 5 seconds) and duration were recorded. The data were analyzed using an analysis of variance (ANOVA) and chi-square analyses. On average, hens spent 55.56 minutes (15.56%) of the observed time perching per bird and used the perch 25 times. Overall, hens with access to square perches had longer total durations of perching (averaged 86.42 minutes) than hens with access to round perches (averaged 25.69 minutes) ($P < 0.0001$). However, there were no significant differences in average perching durations ($P = 0.18$) or perching frequencies ($P = 0.79$) between hens that and did not develop keel bone damage during the 21-day trials. Hens that did develop keel bone damage averaged a duration of 44.87 minutes and a frequency of 21 times whereas control hens averaged a duration of 66.25 minutes and a frequency of 30 times. It is not clear at what point over the 21-day trial the hens in the focal group developed keel bone deviations, or whether one or both of the randomly selected observation days took place before the deviation occurred. Therefore, these results should be considered as preliminary. Expanded observations are being conducted to examine whether perching durations and behaviors may play a role in the development of keel bone deviations.

Undergraduate Student Competition

Poster 9**Comparing measurements of different behavioral responses between a novel environment test and a novel object test in domestic swine**

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Fear responses in domestic animals are a widely researched subject in animal welfare science because fear and stress can lead to injury, fatigue, and abnormal behaviors. In production, fear and stress can have a negative effect on reproduction, growth rate and feed intake. In this study, we investigated different behavioral responses to novelty in pigs because novelty can be seen as a potential threat. Novel environment and novel object tests are validated fear-response tests in pigs. For this study we used a novel environment test immediately followed by a novel object test to see if fear response changed with the presence of an additional stressor. A total of 60 purebred Yorkshire barrows (castrated males) were used. Pigs were 17-wk old at the time of testing and were housed in five grow-finish pens (12-15 pigs/pen). Pigs were moved individually to a novel pen (4.3m x 3.4m) and given a 1-min habituation period before the novel object (a basketball) was introduced. We recorded the frequency of low grunting, high-pitched squeals, standing, running, and urination and defecation. The pigs' responses were observed during the 1-min habituation period and for 1-min after introduction of the novel object. Responses before and after the introduction of the novel object were compared using a paired t-test. During the novel environment test the means and standard errors for each behavior were as follows: low grunting (3.90 ± 0.45), high-pitched squeals (0.03 ± 0.03), standing (0.70 ± 0.11), running (0.22 ± 0.10), urinating and defecating (0.55 ± 0.08). The presence of an additional stressor did have a significant effect on behaviors, increasing the frequency of low grunting (6.77 ± 0.57 , $P < 0.01$), standing (1.57 ± 0.13 , $P < 0.01$), and running (0.72 ± 0.11 , $P < 0.01$). There were decreased instances of urination and defecation (0.32 ± 0.07 , $P = 0.042$). There was no significant difference in high-pitched squeals (0.90 ± 0.46 , $P = 0.058$), although instances of this behavior were low. The results indicate a significance increase in locomotion and vocalization, suggesting an increased fear response to the addition of a novel object.

Undergraduate Student Competition

Poster 10**Influence of genetic strain on resource use by four strains of laying hens in a non-cage aviary****Ahmed B.A. Ali¹, Dana L.M. Campbell², Darrin M. Karcher³, Janice M. Siegford¹**

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In response to consumer demands and legislative measures for improving hens' welfare, many laying hen producers are transitioning from conventional cages to multi-tier aviaries. Aviary resources, such as litter areas, nestboxes, ledges, and perches are intended to encourage hens' expression of natural behaviors. However, commercial laying hen strains have been molded by a variety of selection pressures including traits such as feed efficiency, egg quality, longevity, and behavior. Therefore, the assumption that laying hens are using the given resources similarly, irrespective of their genetic strain, may be false. This research examined the influence of laying hen strains (Hy-Line Brown [HB], Bovans Brown [BB], DeKalb White [DW], and Hy-Line W36) on resource use (litter areas, nestboxes, elevated tiers, ledges, and perches) inside aviaries during peak lay (28 wks. old). Live observation and video-recording of hens' distribution among different resources were conducted at 3 different times (Morning, Midday, and Evening) for 3 consecutive days, 3 wk after hens gained access to litter. Observations were conducted in 16 aviary units; 4 units/strain, 144 hens/unit. Data were analyzed using one-way ANOVAs with Tukey's Post hoc test applied to significant results, and α set at 0.05. More HB and BB (17.6, 16.3) hens were in nestboxes in Morning, compared to DW and W36 (9.3, 10.6; $P=0.01$), and vice versa for Midday (HB=2.6, BB=2.1, DW=8.3, W36=7.1; $P=0.03$). Moreover, Brown hens showed occasional nestbox over-occupancy during the Morning period, while White hens used nestboxes less synchronously and over more time during Morning and Midday. More DW and W36 (56.6, 52.2) hens were on litter compared to BB and HB (38.3, 24.7; $P=0.002$), particularly when litter was first accessible. White hens on litter occupied open areas in higher numbers (DW=43.1, W36=41.9; $P=0.01$), while more Brown hens occupied litter under the aviary (BB=19.63, HB=17.9; $P=0.04$). Throughout the day, Brown hens occupied wire floors in higher numbers than White hens, while the latter were more on both ledges and perches, (all $P\leq 0.05$). Distinct strain differences indicate that attention should be paid to the match between configuration of the aviary design and strain of laying hen.

Poster 11**Frequency of culling by sow housing type as reported by North American pork producers****Sarah H. Ison, Ronald O. Bates, Juan P. Steibel, Catherine W. Ernst, Janice M. Siegford**

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In North America, regulations and consumer pressure are driving a change from gestation stalls to group sow housing (GSH), but pork producers are concerned about welfare and productivity in GSH. We investigated the frequency of culling by gestation housing type and sow removal from GSH to be isolated for treatment due to illness/injury, using an online survey to North American pork producers. Respondents selected how they housed gestating sows ('in groups', 'in individual stalls', or 'some in stalls/some in groups'), and how often ('very often', 'quite often', 'sometimes', 'rarely', 'never') they culled sows for various reasons. Those with GSH were asked how often sows were removed for treatment due to lameness, injuries, aggression, and illness. Chi-square tests of homogeneity compared frequencies of culling, culling by type of housing, and sow removal. Respondents with sows in groups only, had a different type of operation (small scale farms), so reasons for culling were compared between the two types: stalls with some in stalls/some in groups. Respondents (n=243), had sows in groups (46%), in individual stalls (20%), or some in stalls/some in groups (34%). The breeding pig replacement rate was lowest for farms with only group housing (26.5±2%), but similar for stalls (42.8±2.8%), and some in stalls/some in groups (42.7±1.9%). The order from most to least often reported reason for culling across all systems was: old age/high parity^a, reproductive failure^b, poor litter performance^b, poor maternal behavior^c, lameness^c, aggression towards sows^d, difficult to manage^e, and aggression towards humans^e (reasons with different superscript letters differed in pairwise tests, $P<0.05$). Culling for poor maternal behavior was more often given as a reason for culling sows housed in stalls compared with some in stalls/some in groups ($P=0.05$), but no other reasons for culling differed between these two housing types ($P>0.05$). Sows were most often isolated from GSH for lameness^a (48% selecting at least sometimes), followed by injuries^{a,b}, aggressive behavior^{b,c}, and other illnesses^d (reasons with different letters = $P<0.05$). Farms with some sows in stalls/some in groups reported similar reasons for culling and had similar mean sow replacement rates to farms with stalls only.

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