12th Annual CCSAW Research Symposium – 2019

May 8th, 2019 9:00am – 4:00pm (registration at 8:30am)

Welcome
9:00   Dr. Malcolm Campbell, Vice-President (Research), University of Guelph

Session #1: Poultry I
(Chair: Dr. Tina Widowski, Animal Biosciences)
9:15   **Behavioural and physiological effects of prenatal stress in different genetic lines of laying hens**
Mariana Peixoto*, Tina Widowski

9:30   **The effect of omega-3 enriched maternal diets on social isolation vocalisations in ISA brown and Shaver white chicks**
Rosemary Whittle*, Reza Akbari Moghaddam Kakhki, Elijah Kiarie, Tina Widowski

9:45   **Modulation of tryptophan metabolism and feather pecking by probiotic bacteria in laying hens**
Claire Mindus*, Nienke van Staaveren, Haylee Champagne, Paul Forsythe, Johanna M. Gostner, Joergen B. Kjaer, Wolfgang Kunze, Dietmar Fuchs, Alexandra Harlander

Poster Introductions
(Chair: Dr. Derek Haley, Population Medicine)
10:00   1-min intros to posters

10:20   Visitor Welcome

10:30   **POSTER SESSION & COFFEE BREAK – 60 min**

Session #2: Poultry II
(Chair: Dr. Stephanie Torrey, Animal Biosciences)
11:30   **How excreta and ammonia reductant application affect turkeys' perceived value of wood shavings**
Valerie Monckton*, Nienke van Staaveren, Peter McBride, Isabelle Kwon, Alexandra Harlander

11:45   **Assessing the play behaviour of fast-growing broilers reared in pens with or without enrichment**
Zhenzhen Liu*, Stephanie Torrey, Ruth Newberry, Tina Widowski

12:00   **LUNCH – 75 min**

Session #3: Mice, mink, fish and cats
(Chair: Dr. Georgia Mason, Animal Biosciences)

1:15 **Risk factors for aggression in adult cats that were fostered through a shelter program as kittens**
Kristina O'Hanley*, David Pearl, Lee Niel

1:30 **Tell-tail: Identifying fear behaviours in kittens**
Courtney Graham*, David Pearl, Lee Niel

1:45 **Identifying enriched housing conditions for zebrafish (*Danio rerio*) that vary along a scale of preference**
Michelle Lavery*, Victoria Braithwaite, Noam Miller, Georgia Mason

2:00 **Active use of manipulable objects does not reliably predict welfare benefit in young American mink (*Neovison vison*)**
Samuel Decker*, Georgia Mason

2:15 **Are "depression-like" responses in mice really depression?**
Aileen MacLellan*, Basma Nasal, Aimee Adcock, Emma Nip, Georgia Mason

2:30 **COFFEE BREAK – 30 min**

Session #5: Swine and cattle
(Chair: Dr. David Renaud, Population Medicine)

3:00 **Tryptophan as a behaviour and growth modifier in growing pigs**
Maggie Henry*, Robert Friendship, Anna Shoveller, Anita Tucker

3:15 **Efficacy of pain control for caustic paste disbudding in very young calves**
Cassandra Reedman*, Todd Duffield, Trevor DeVries, Kerry Lissemore,
Niel Karrow, Ziwei Li, Charlotte Winder

3:30 **Detection of dairy cow mastitis using milking and behaviour data from robotic milking systems and deep learning models**
Meagan King*, Syed Naqvi, Marc Champigny, Rob Deardon, Herman Barkema,
Trevor DeVries

Closing Remarks

3:45 **Student Awards & Acknowledgements**
Derek Haley & Lee Niel

4:00 **End**

POSTER PRESENTATIONS

1. **The elephant in the room: The often neglected relevance of speciesism in dehumanization and bias towards ethnic minorities/immigrants**
Melisa Choubak*, Saba Safdar

2. **Does feather loss reduce aerial activity and induce muscle atrophy and keel bone damage in laying hens?**
Renee Garant*, Alexandra Harlander

3. **Examining the horse-human bond from the human perspective**
Daniela Hayman*, Katrina Merkies

4. **Understanding the impact of managed intake as part of capacity for care**
Samantha Hobson*, Shane Bateman, Jason Coe, Lisa Veit, Michelle Oblak

5. **The impact of osteoarthritis pain on canine cognitive function**
Emma Lamoure*, Mark Hurtig, Lee Niel

6. **The effect of police horse training on the behavioural and physiological responses to different environments encountered on the job**
Emma Lewis, Ciara McPhedran, Tiffany Boyer, Katrina Merkies*

7. **A risk factor analysis of health traits in turkeys (Meleagris gallopavo) on Canadian farms**
Emily Leishman*, Nienke van Staaveren, Sarah Adams, Ben Wood, Alexandra Harlander, Christine Baes

8. **The influence of enrichment on leg parameters in a conventional strain of broiler chicken**
Midian Nascimento dos Santos*, Daniel Rothschild, Tina Widowski, Zhenzhen Liu, Stephanie Torrey

9. **Effects of rest stop station conditions on behaviour, health, and performance of beef cattle transported long distances in Canada**
Paula Olivares Guzman, Karen Schwartzkopf-Genswein, Tina Widowski, David Pearl, Derek Haley*

10. **Commercial aviary rearing systems and their effect on locomotory behaviour in pullets**
Amanda Pufall*, Michelle Hunniford, Tina Widowski

11. **Risk factors of competitive tendencies and fearfulness in puppies**
Quinn Rausch*, Samantha White, Lee Niel

12. **Early environmental effects on laying hen behavioural, cognitive and musculoskeletal development**
Ana Rentsch*, Erin Ross, Tina Widowski

13. **The effect of enrichment on organ growth, cardiac myopathies, and bursal atrophy in a conventional strain of broiler chicken**
Daniel Rothschild*, Midian Nascimento dos Santos, Zhenzhen Liu, Tina Widowski, Stephanie Torrey

14. **Risk-factors associated with veterinary-related fear and aggression in owned domestic dogs**
Anastasia Stellato*, Hannah Flint, Cate Dewey, Tina Widowski, Lee Niel

15. **Optimizing pet rabbit care and welfare, and the owner-rabbit bond**
Carol Tinga*, Lee Niel

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STUDENT AND POSTDOCTORAL VOLUNTEERS:

Aitor Arrazola	Claire Mindus	Nienke van Staaveren
Lauren Dawson	Midian Nascimento Dos Santos	Rose Whittle
Courtney Graham	Mariana Roedell	Shynice Williams
Maggie Henry	Misha Ross	
Meagan King	Daniel Rothschild	
Michelle Lavery	Carol Tinga	

The elephant in the room: The often neglected relevance of speciesism in dehumanization and bias towards ethnic minorities/immigrants

Melisa Choubak[*], Saba Safdar

Applied Social Psychology, University of Guelph, Guelph, ON, Canada

The area of intergroup bias and, specifically, attitudes towards dehumanized groups, such as ethnic minorities and immigrants, has received a great amount of investigation, spanning many theories and perspectives (Hewstone, Rubin & Willis, 2002). However, one perspective that has rarely been taken in mainstream Psychology is one that acknowledges the inter-linkage of bias towards ethnic minorities and immigrants and that towards non-human animals (NHAs). This is despite a relatively substantial literature outside of Psychology emphasizing it (Singer, 2002). Scholars from critical animal studies, history, philosophy etc. (e.g. Kalof, 2007; Nibert, 2002) postulate that the sub-ordination of NHAs in Western culture (or speciesism; Singer, 2002) intersects with and reinforces other types of 'isms', such as ethnocentrism. Psychology, also, to some extent, has offered us some insight into this connectivity, e.g. per the research domain of dehumanization or the likening of ethnic minorities and immigrants to de-valued NHAs (Haslam, 2006), and by offering relevant psychological theories that speak to the 'othering' of out-groups (e.g. Social Dominance, Social Identity; Sidanius & Pratto,1999; Tajfel, 1979). In addition, a relatively recent model, the Interspecies Model of Prejudice, connects bias held towards NHAs to bias held towards human out-groups (Costello & Hodson, 2010). This poster will focus on this connection in an attempt to spark discussion for those interested in contributing further to trans-species research on bias and oppression.

Active use of manipulable objects does not reliably predict welfare benefit in young American mink (Neovison vison)

Samuel T. Decker*, Georgia J. Mason

Animal Biosciences, University of Guelph, Guelph, ON, Canada

For potential enrichments to effectively improve welfare, it is often assumed they should attract sustained interest from the animals they are given to. The NFACC Code of Practice for farmed American mink suggests this, and 'habituation' to enrichments is often argued to be a problem in zoo animals too. This study aimed to test the hypothesis that active use of manipulable objects predicts welfare improvement, using mink as a model carnivore. Juvenile mink were housed in male/female pairs (N = 133 pairs; half being demi colour-type [D] and half pastel [P]). The objects used were perforated plastic golf balls and PVC rings. In July 2018 (age: 12 wks.), pairs were assigned to one of four provision schemes: (1) 'Baseline', the minimum code requirement of one item (ball or ring); (2) 'Number', four items of a single type (balls or rings); (3) 'Diversity', two of each item type (two balls and two rings); or (4) 'Novelty', two items of a single type with two of the other type added at 18 wks. (e.g. two balls at 12 weeks, plus two rings added at 18 weeks). At 25 wks., females were transferred to new cages, with only males still having access to provided items. Welfare was assessed at 17 and 23 wks. via stereotypic behaviour (SB) and fearfulness in 'glove tests', and at 27 wks. via boredom-like states inferred from exploratory responses to diverse stimuli (males only). Active use was recorded at 17, 23, and 26 wks. Proportion data (active use, SB, and fear) were analyzed with generalized linear mixed models and timed responses (boredom-like state tests) were analyzed with general linear mixed models. Fixed effects included sex, colour-type, and treatment (item type [Baseline/Number] or order [Novelty]) nested in provision scheme. At 17 wks., item Diversity increased active use over Baseline in all mink save P females (P female $X^2(3)=2.92$, $P = 0.40$; D female $X^2(1)=10.37$, $P < 0.01$; males $X^2(1)=31.68$, $P < 0.001$). Only D males still showed this Diversity effect on active use in October ($X^2(1)=4.12$, $P < 0.05$), and none did once single-housed ($X^2(3)=1.41$, $P = 0.70$). Rings also typically received more active use than balls ([17 wks.] female $X^2(1)=8.05$, $P < 0.01$; male $X^2(1)=56.98$, $P < 0.001$; [23 wks.] P female $X^2(1)=6.95$, $P < 0.01$; P male $X^2(1)=11.14$, $P < 0.001$). If welfare improvement relied on active use, mink in the Diversity scheme should therefore have better welfare than Baseline, and mink with rings should have better welfare than those with balls. However, the Diversity scheme did not decrease SB, fearfulness, or boredom-like states over Baseline or other schemes, and item type effects were also rare and inconsistent. Analyses are ongoing, but so far, because the provision scheme and item that most increased active use did not correspondingly improve welfare, how much active use manipulable objects attract may not be the best way to assess their efficacy as enrichments.

Does feather loss reduce aerial activity and induce muscle atrophy and keel bone damage in laying hens?

Renée C. Garant[*], Alexandra Harlander

Animal Biosciences, University of Guelph, Guelph, ON, Canada

In the wild, many species of birds undergo a partial moult in which their old and damaged wing feathers are shed and replaced with new ones. As new feathers are slow to grow in, birds may be missing primary wing feathers for extended periods resulting in decreased aerial activity, and atrophy of the flight muscles. Human trials have proven that exercise and trained muscles are important for the maintenance of bone health, but it is unknown if the same is true for birds. In commercial laying hens, wing feather loss commonly occurs as a result of feather pecking from cage mates, as well as abrasions due to housing structures. The pectoralis wing muscle is thought to protect the keel bone. However, it is unknown whether partial feather loss in laying-hens results in flight muscle atrophy, and subsequently keel bone damage (KBD). Previous studies have demonstrated that KBD is a painful condition and one of the greatest welfare challenges facing the commercial egg production industry. Therefore, the aim of the present study is to determine the relationship between muscle use/disuse and KBD. We hypothesize that hens with clipped primary feathers (2 most distal primary feathers) will become less aerial and show flight muscle atrophy, resulting in weakened muscles and a keel bone that is more prone to damage. This study will include 120 female adult (25 weeks) leghorn laying hens housed in enriched aviaries (30 birds/pen) with access to elevated perches and incline ramps. Birds will be assigned to 6 "wing feathers clipped" or 6 unclipped (control) groups. Throughout an 8-week period, muscle mass of the pectoralis muscle and keel bone fractures/deviations will be assessed bi-weekly with the use of portable ultrasound. Activity levels of individual birds will be assessed with data loggers that record aerial activity and ground locomotion throughout the entire experiment. Data analyses will be conducted using the GLIMMIX procedure in SAS 9.4. We predict that birds with two clipped primary feathers will show pectoralis muscle atrophy, an increase in locomotion on the ground, a decrease in elevated tier use, and an increased risk of keel bone damage. It is our aim to gain a better understanding about the causes of keel bone damage so that we may continue to improve the welfare for future generations of laying hens.

Tell-tail: Identifying fear behaviours in kittens

Courtney Graham[*], David L. Pearl, Lee Niel

Population Medicine, University of Guelph, Guelph, ON Canada

Fear is a negative emotional state and can impact animal welfare. Early socialization, including exposure to novelty, can help mitigate fear in later life. We have some knowledge of what fear looks like in adult cats, but fear behaviours in kittens have not been properly identified through controlled studies. We assessed which kitten behaviours occur in response to novel stimuli, as identified through avoidance. Foster kittens (6–7 weeks of age; n=20) were tested in home. Initially, they were habituated as a litter (n=6; 2–5 kittens per litter) for 5 min to a soft-sided pet exercise pen (1.2 m^2 X 0.7 m h), and then removed. Next, each kitten was placed back into the pen individually for seven trials: three stimulus trials with a noisy and unpredictable novel stimulus alternated with four trials with no stimuli (control). Stimuli included a plush cat paired with an audio recording of meowing and hissing, a plush dog paired with an audio recording of barking and growling, and a hand vacuum pulsed on and off. Order of stimulus presentation was randomized for each kitten. Each presentation lasted 10 s and was followed by 30 s of observation without the stimulus; total trial time was 40 s. All sessions were video-recorded, and behaviour during each trial (n=136; four trials were removed due to recording error) was scored by a blinded observer using Noldus Observer XT 12 event logging software. Trials were categorized as 'fearful' if the kitten showed avoidance during a stimulus trial, and responses during these trials were compared to control trials. Mixed linear, logistic, and negative binomial models, with litter and kitten as random effects, were used to assess associations for behaviour durations, occurrence, and counts, respectively, and included trial type (control/fearful) and stimulus type (cat/dog/vacuum). Durations of tucked tail (P=0.011), piloerection (P<0.001), and freezing (P=0.039) were greater in fearful trials compared to control trials, whereas durations of upright tail (P=0.030) and eating (P=0.002) were lower in fearful trials. The odds of showing arched back posture (P=0.039) and the rates of ears back (P<0.001) and hissing (P=0.042) were greater in fearful trials. Further, the durations of arched back posture, piloerection, and freezing, and the rate of ears back were significantly greater with the dog stimulus, whereas the duration of tucked tail was greater with the vacuum stimulus. No significant differences were found for lowered head, hesitant walking, hiding behind or inside of a retreat area, lip licking, paw lifts, rears, or meowing. Overall, these results indicate that arched back posture, piloerection, tucked tail, freezing, ears back, and hissing are indicative of fear in kittens in the presence of fear-provoking stimuli. These responses are similar to those reported for adult cats, suggesting that the behavioural repertoire for fear in kittens is fully developed by 7 weeks of age.

Effects of rest stop station conditions on behaviour, health, and performance of beef cattle transported long distances in Canada.

Paula Olivares Guzman[1], Karen Schwartzkopf-Genswein[2], Tina Widowski[3], David Pearl[1], Derek Haley[1]*

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[2] Agriculture and Agri-Food Canada, Lethbridge, AB, Canada
[3] Animal Biosciences, University of Guelph, Guelph, ON, Canada

The cow-herd population in Ontario is lower than our feedlot capacity, so the long-distance transportation of beef calves from western Canada into Ontario feedlots is a regular occurrence. In January 2019 the Health of Animals Act was amended (to take effect in February 2020), reducing the maximum transport duration for weaned cattle from 48 to 36 h, after which they must be unloaded, fed, watered and rested for at least 8 h (presently 5 h). There is a lack of science-based information regarding the relationship between rest stop duration and quality, and cattle behaviour and health outcomes. OBJECTIVES: 1) To benchmark the characteristics and behaviour of cattle commercially transported long distances, at two rest stations, near Thunder Bay, ON (TB); 2) To determine whether providing straw bedding at the rest station alters cattle behaviour; and 3) To study the effects of long-distance transport on cattle, upon arrival to Ontario feedlots, on behaviour and health. METHODS: 1) Drivers (N=60) will be surveyed about their professional experience, the characteristics of the trailer, trip, and animals. The general activity (e.g., lying, drinking and eating) of cattle will be recorded (N=60 loads) for 8 h at the two commercial rest stations near TB; 2) At the rest stations, we will assess whether providing bedding (vs the present standard, dirt floor) impacts the latency of cattle to lie down, and lying duration of beef cattle (N=60 loads) by exposing half the animals from each load, to the bedding treatment; 3) Upon arrival to Ontario feedlots, drivers (N=20) will respond to the same survey used in 1. The general activity of cattle at the rest station (mid-point) will be compared to what the same animals do at the destination, to see whether rest station quality (bedding or not) has any impact on behaviour outcomes. This will be the first time cattle transported long distances will have been systematically examined at their final destination. Additionally, health (morbidity, mortality) and performance (ADG, feed conversion) will be recorded for 30 d at the destination, to model the effects of journey characteristics and the quality and duration of rest stops, on these outcomes. It is expected that providing bedding at rest stations will result in a shorter latency, and longer duration, of lying. As a result of better rested cattle, we hypothesize that, morbidity and mortality will be reduced and ADG and conversion improved, in the feedlots. Results from the present studies will help establish evidence-based standards and Best Management Practices for providing a quality feed, water, and rest station experience to beef cattle being transported long distances. Ultimately, this should improve the well-being of the cattle, the profitability of beef producers, and public perception of cattle transportation practices.

Examining the horse-human bond from the human perspective

Daniela Hayman*, Katrina Merkies

Animal Biosciences, University of Guelph, Guelph, ON, Canada

The relationship between horses and humans is one that many people would perceive as being unique. They tend to classify it as such using any number of reasons, for instance the horse behaving or responding differently exclusively for them. A better understanding of this bond and how it is classified from a human perspective provides insight into where pitfalls for welfare might occur, especially in instances where the horse-human bond is romanticized and seeking it is prioritized to the detriment of the horse's comfort or wellbeing. As a preliminary step toward better understanding the horse-human bond, this exploratory study sought to expound on the reasons through which people believe there is a bond between a horse and a human and to determine any significant patterns. A survey on horse-human attachment relationships, hosted on the online platform Qualtrics, was distributed to the Horse Canada website and various social media groups (e.g. the ISES closed Facebook group). Participants' (n=444) demographic data was collected, including gender, age, ethnicity, household income and country of residence. Questions were also asked about horse ownership, days per week of one-on-one contact, length of time the participant had been riding the horse and their primary reason (Western riding, English riding, etc.) for spending time with the horse. Finally, an open-ended question asked them to describe an instance where a horse had done something that made the participant think a bond between a horse and a human had been demonstrated. Responses to the open-ended question were cleaned (e.g. fixed spelling errors) and uploaded to NVivo software for qualitative analyses. They were then coded to 18 categories describing the participant's interaction with the horse (e.g. greeting) for a total of 920 references. While statistical analyses are ongoing, preliminary analysis of frequency counts showed the following five categories as appearing most often: the horse voluntarily approaching the human (121 references), the horse vocally greeting the human (90 references), the horse trusting the human (78 references), the horse taking care of the human (74 references) and the horse initiating physical contact with the human (73 references). Thus far, this indicates that the bond can indeed be classified through common themes. It is anticipated that examining these percentages in correspondence with the demographic data will reveal significant patterns as well. This has relevant implications for improving the welfare of horses, as a better understanding of the horse-human bond means people can learn to work better with their horse to avoid accidents, decrease their stress in adverse situations, and improve cohesiveness in training.

Tryptophan as a behaviour and growth modifier in growing pigs

Maggie Henry*[1], Robert M Friendship[1], Anna K Shoveller[2], Anita L Tucker[1]

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[2]Animal Biosciences, University of Guelph, Guelph, ON, Canada

In growing pigs, aggression and aberrant behaviour such as tail- and ear-biting can result in decreased growth, diminished health and welfare, increased morbidity and mortality, increased labour on the part of the producer and significant economic loss to the producers and the industry. Tryptophan (TRP), an essential amino acid in the diet, is known to diminish aggression in humans and rats through the serotonergic system, however, this has not been examined in pigs. The objectives of this study were to determine the effect of varying inclusion rates of dietary TRP on aggression, aberrant behaviour and growth in grower pigs. This study examined the effects of 3 feed treatments on a total of 90 grower pigs (over 2 concurrent trials) divided equally across the 3 diet treatments. Sex, weight and litter origin were balanced across pens in each trial. There were 5 pigs/pen and 3 pens/treatment/trial. This feeding trial lasted a total of 29 days/trial, with feed and water being fed *ad libitum*. A single diet was formulated based on providing all nutrients at or above their estimated National Research Council (NRC) requirements, and providing TRP at 100% of its standard ileal digestible (SID) requirement. Amino acid mixtures were then added to the base diet to provide: 1) Control diet (TRP at 100% SID requirement), 2) TRP at 175% of its SID requirement, and 3) TRP at 250% of its SID requirement. From day 1 to 8 all pens received the control diet. On day 8, pens that were assigned to the 2 high-TRP diets began receiving their specific feed, while control pens continued receiving the control diet. All pigs had tail, ear and scratch score lesions recorded, as well as their weight taken, on day 1, 8, 15, 22 and 29. All feed was weighed and feed intake was measured for the duration of the trials on a pen level. All pigs had continuous behaviour recording done for 12 hours (06:00-18:00) 3 days/week using a video recorder for later analysis. An ethogram was used to examine 13 mutually exclusive behaviours while video analysis occurred. Plasma and serum samples were taken from 3 pigs/pen (N=27/trial) at four different time points (day 8, 15, 22 and 29) to measure TRP and serotonin levels. Ultra Performance Liquid Chromatography and Enzyme-linked Immunosorbent Assay will be used to measure the plasma TRP and serotonin levels, respectively. Data from both trials were pooled and statistical analysis was carried out using SAS 9.4. Tail-biting was not observed over the duration of the trials, and no difference in feed intake, growth, or aberrant behaviour was found to be statistically significant during the trials ($P>0.05$). Plasma and serotonin samples continue to be analyzed, but it appears that TRP levels in excess of NRC requirements did not have a beneficial effect on growth, aggression or aberrant behaviour in grower pigs.

Understanding the impact of managed intake as part of capacity for care

Samantha J. Hobson[1], Shane Bateman[1], Jason B. Coe[2], Lisa Veit[3], Michelle Oblak[1]

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[2]Population Medicine, University of Guelph, Guelph, ON, Canada
[3]Guelph Humane Society, Guelph, ON, Canada

Cat overpopulation has a large impact on animal shelters who aim to improve the welfare of animals in the communities they serve. Capacity for Care (C4C) is a shelter management strategy in which the population is maintained at or below a predetermined capacity unique to each facility, in order to improve the quality of care provided to animals during their time at the shelter. Managed intake is used as part of C4C to slow or divert intake when shelter resources cannot accommodate more cats. Evidence suggests that C4C is an effective strategy to improve welfare in shelter facilities and to increase live outcomes for cats. The aim of this research is to describe the distribution of outcomes for cats who are waitlisted or diverted as part of managed intake and to further understand the impact of C4C on the community beyond the shelter. Data were collected from the Guelph Humane Society (GHS) on 298 cats whose owners contacted the shelter to discuss issues that may potentially have led to the decision to surrender their cat. Data included cat demographic information, the circumstances which may have resulted in surrender, surrender waiting periods, rehoming options that owners were considering when they initially reached out to the GHS, and outcomes for the cats. The data were analysed to characterize the population of owned cats whose owners contacted the shelter for assistance and to describe their outcomes. A second qualitative study is being conducted to 1) explore the relationship between cats and their owners while they are on a waitlist to relinquish their cat and 2) examine the impact of to managed intake and deferred relinquishment on cats and their owners. Ten participants will complete an initial interview before creating a one-week photo diary to depict their relationship with their cat and how they have been influenced by managed intake. Upon completion of the photo diary, a one-on-one interview is conducted to review the photos and for participants to share their experiences. Interview transcripts will be transcribed and coded inductively for thematic analysis. The intention of C4C is to improve conditions for animals in shelter facilities however, shelter practices have an impact on the welfare of the entire companion animal community. This research will provide an evaluation of the impact of C4C beyond the shelter system, which may have implications for how shelters can better support community members and their cats while using managed intake.

Detection of dairy cow mastitis using milking and behaviour data from robotic milking systems and deep learning models

Meagan T.M. King[1]*, Syed A. Naqvi[2], Marc Champigny[3], Rob Deardon[2], Herman W. Barkema[2], Trevor J. DeVries[1]

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In Canada, 10% of dairy farms now use automated milking systems (AMS). Many AMS are coupled with electronic sensors to monitor cow behaviour and health, potentially helping farmers catch illness sooner and intervene before it becomes more severe, improving cow welfare. With the abundance of data collected by AMS comes the need for reliable, validated algorithms for disease detection. Deep learning models use a series of connected neurons to identify complex relationships between predictor variables and the outcome of interest (disease probability). Recurrent neural networks capture complex, time-dependent relationships and base predictions on individual animal patterns. The objectives of this study were to: 1) integrate AMS data to develop accurate mastitis detection models using recurrent neural networks; 2) determine the relative importance of variables and their effect on model performance; and 3) assess the accuracy of our models. Milking data (including milk yield, visit frequency, duration, temperature, conductivity), cow behaviour (rumination time, activity), cow data (days in lactation, parity), and mastitis treatment records were collected from 13 commercial AMS dairy herds in Ontario, Canada for the first 30 d of lactation for 822 cows. Clinical mastitis was diagnosed when a cow had poor quality or quantity of milk production, as measured by the AMS, and abnormal milk or udder upon visual examination, and the cow was treated using an antimicrobial. Farms were divided into 3 groups: 9 farms for model training and development (n=240 cows, 20 mastitis cases), 2 farms for model testing (n=81 cows, 6 mastitis cases), and 2 farms for hold-out validation. Initial models were run only using healthy cows (no recorded health disorder) and cows having only mastitis. Deep learning models were trained to predict the daily probability of a cow being diagnosed with mastitis, based on 54 possible input variables (i.e. milking, behaviour, and cow data, for each milking and variance for each day). Recurrent neural networks, with 3 long short-term memory cells, were trained using different lengths of time windows when cows were classified as sick for 3, 5, 7, and 15 d centered around diagnoses. Using a combination of milk and behaviour data and prediction windows of 3, 5, 7, and 15 d centered around the day of diagnosis, models achieved 82, 85, 79, and 93% accuracy during testing, respectively. Excluding behaviour data reduced prediction accuracy by 5% units. Excluding daily variances reduced prediction accuracy by 7% units. Overall, these methods and resulting algorithms have great potential to improve the reliability and timeliness of automated mastitis detection for dairy producers using AMS. Future work will assess the timeliness of predictions and validate the model using cross-validation, hold-out validation, and external validation, in addition to creating more models to detect different types of illness.

The impact of osteoarthritis pain on canine cognitive function

Emma Lamoure[1]*, Mark Hurtig[1], Lee Niel[2]

[1]Clinical Studies, University of Guelph, ON, Canada
[2]Population Medicine, University of Guelph, ON, Canada

Osteoarthritis (OA) is a degenerative joint disease and the most commonly diagnosed form of arthritis in human medicine. It affects millions of people worldwide and is prevalent in veterinary practice impacting one in four dogs. One of the primary symptoms of OA is chronic pain. If unmanaged, chronic pain can lead to an upregulated sensitivity and elevated pain response referred to as central sensitization. This increased sensitivity can result in a negative shift in cognitive bias, affecting subsequent behaviour and decision-making. Currently, there are few studies identifying the effects of pain on cognitive function. For the current study, the primary objective is to demonstrate how OA-specific pain influences cognitive function in dogs based on a series of cognitive tasks. The proposed study will be conducted utilizing animals in a trial for a new drug designed to prevent the advancement of OA. OA will be surgically induced via meniscal destabilization. Therapy consists of an intra-articular injection of the drug administered six weeks after surgery to model the therapy after established early to mid-stage OA. The dogs in the current study will be stratified according to pain scores in order to account for the effects of the drug and individual levels of sensitization to establish a relationship between pain and cognitive function. Twenty-four foxhounds will be trained over six weeks to complete a series of tasks which will assess different areas of cognitive function. In order to assess the affective state of the dogs, a cognitive bias test will be conducted, with impulsivity tested through the cylinder detour test, risk analysis via decision-making with the delay of gratification test and problem solving through the unsolvable task paradigm. Additionally, dogs will be trained to complete a series of obstacles, such as stairs and platforms, and participate in standardized play to assess how pain interferes with locomotor function. A composite pain severity score will be developed using scores from both the daily Colorado Pain Scale and the weekly Canine Brief Pain Inventory. Baseline cognitive scores, obstacle completion and play duration for all dogs will be taken prior to surgery. Post-OA tests for each dog will be completed again 18 weeks after surgery. A Spearman's correlation test will be conducted between the pain scores and the cognitive test results. From this study, we hypothesize that dogs will exhibit an increased negative affective state, increased impulsivity, poor decision-making and decreased problem solving, as OA pain scores increase. Furthermore, it is anticipated that dogs with increased pain scores will take longer to complete obstacle tasks and participate in play for shorter periods of time. This knowledge will allow us to further our understanding of the impact of OA pain on canine cognitive function and allow translation to future human studies.

Identifying enriched housing conditions for zebrafish (*Danio rerio*) that vary along a scale of preference

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Widely used in research, zebrafish (*Danio rerio*) are typically housed in small, barren tanks. Environmental enrichment (EE) can improve their welfare, but only a few EEs have been assessed for zebrafish. Although in other species more highly preferred EEs are known to produce better welfare states, current work on which EEs zebrafish most prefer is limited to just two studies, both with limited group replication (n_{groups}=1-5). We therefore aimed to assess zebrafish preferences for 13 putative EEs. These were black walls or walls with an underwater image; sloped or flat aquarium gravel; plastic grass or overhanging plants; the ability to see fish in neighbouring tanks; and combinations of these treatments. Twenty replicate groups of 8-10 adult TU strain zebrafish were housed in 19 L tanks. Groups underwent 13 consecutive preference tests (typically 10 groups per test, with the other 10 groups also being tested whenever results were trends [$0.10 < P < 0.05$] and thus ambiguous), with putative EEs installed on opposite sides of the tank (randomised across groups). Habituation to new treatments lasted at least three days, immediately after which fish preference stability was evaluated. Once preferences were stable (which took 4-12 days and was assessed using Lin's Concordance Correlation Coefficient), the number of individuals on each side of the tank was collected for each group at intervals of 10, 15, or 30 minutes (depending on the results of correlation analyses performed to optimize efficiency and accuracy of data collection), over the following three days. These were then analyzed with one-sample *t* or Wilcoxon signed rank tests. Preferred EEs were never taken away once fish had experienced them; new EEs to be tested were simply added. Fish preferred both gravel morphologies over standard bare floors (sloped: 77.12%, $t(9) = 15.25$, $P < 0.001$; flat: 77.16%, $t(9) = 9.93$, $P < 0.001$); gravel over grass (58.82%, $t(19) = -3.57$, $P = 0.001$); both types of plants and gravel over grass or gravel alone (vs. grass alone: 67.77%, $t(19) = -7.64$, $P < 0.001$; vs. gravel alone: 69.71%, $t(9) = 10.99$, $P < 0.001$ [with grass] and 66.92%, $t(9) = 8.19$, $P < 0.001$ [with overhanging]), and more (i.e. four) grass plants over fewer (i.e. two) (58.68%, $V(19) = 105$, $P < 0.001$). They were indifferent to wall type (when in barren tanks: 55.77%, $t(9) = 1.35$, $P = 0.21$ [black] and 45.30%, $t(9) = -1.75$, $P = 0.11$ [underwater scene]; if combined with four grass plants and gravel: 53.75%, $V(9) = 12$, $P = 0.23$ [black] and 49.46%, $t(9) = -0.13$, $P = 0.89$ [underwater scene]); visual contact with neighbouring tanks (52.57%, $t(9)=1.13$, $P = 0.28$); and between plant types if present in equal numbers (50.00%; unanalyzable due to the many ties). Given this series of results, we can place the preferred EEs along a scale from least preferred to most: grass < gravel < two grass plants+gravel < four grass plants+gravel. As zebrafish research facilities continue to grow in number, these results will aid the effective implementation of enrichment, since researchers can now provide different degrees of preferred EE depending on their research question, resources, and ethics. Our next work will evaluate how these different degrees of EE affect welfare state when provided long-term.

A risk factor analysis of health traits in turkeys (*Meleagris gallopavo*) on Canadian farms

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Current production systems for commercial turkeys can lead to challenges including the development of footpad dermatitis (FPD) and aggressive pecking. Both have welfare and economic implications for turkey production. To date, there have been no epidemiological studies conducted in Canada on risk factors for either FPD or aggressive pecking. An inventory of housing and management practices on turkey farms will be taken in a cross-sectional study using a closed-question survey covering topics on bird characteristics, lighting, air quality, litter quality, feeding, and health. It will be disseminated to over 500 commercial turkey farms in Canada. Additionally, farmers will be asked to take an inventory of the health status of the turkeys on their farms using illustrated instructions to score head injuries, skin damage, and FPD on a subset of 30 birds from a chosen flock. The information on head injuries and skin damage will provide insight into aggressive pecking within the flock. Farmers will score these areas on a three-point scale where a score of zero indicates no damage and two indicates severe damage. The data obtained from this survey will be used to 1) estimate the prevalence of footpad dermatitis and pecking injuries, 2) describe housing and management practices, 3) identify risk factors for FPD and pecking injuries and 4) make recommendations to reduce the prevalence of FPD and pecking injuries. With the information from this study we plan to develop a management tool tailored to the Canadian industry to reduce FPD and pecking injuries on Canadian farms.

The effect of police horse training on the behavioural and physiological responses to different environments encountered on the job

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Police horses are exposed to high stress environments for which they must be appropriately trained using gradual desensitization techniques that ensure their overall well-being and the safety of police officers and public. This exploratory study examined the physiological and behavioural stress police horses experience during training and while on duty in the community and on the streets. Behavioural and heart rate (HR) data from five police horses and six police officers from the Hamilton Mounted Police Unit were collected on three occasions in each of three different environments: 1) training (arena exercises), 2) community patrols (public presentations) and 3) street patrols (night patrol). Heart rate monitors were placed on each horse and rider with data being collected in 5-sec intervals throughout each trial. Behavioural Observation Research Interactive Software (BORIS) was used to retrospectively score behavioural data from 2-minute video segments recorded in 30min intervals for the duration of each trial. Five-second interval sampling from each video recorded the position of the horse's left ear, head and neck position, gait, mouth and tail movement, restlessness, rooting and interaction with people or objects. A GLM with repeated measures analyzed the occurrence of behaviours and horse and human HR among the three environments. Gait was used as a covariate to account for physical exercise impacts on HR. Horse HR was highest during training (84 ± 32^a beats per minute (bpm)), intermediate on the streets (69 ± 33^b bpm) and lowest during community (44 ± 13^c bpm), even when including gait as a covariate (a,b,c differ, $P<0.0001$). Rider HR was highest during training (115 ± 16^a bpm), intermediate during community (94 ± 18^b bpm), and lowest on the streets (86 ± 17^c bpm; $P<0.0001$), indicating that rider responses differed from horse responses. Compared to the community and street environments, during training the horse's ear was focused towards the rider more often ($37\%^a$, $40\%^a$ and $59\%^b$ of the time respectively; a,b differ $P<0.0001$), the head was raised more often ($0.8\%^a$, $1.3\%^b$ and $3.5\%^c$ of the time respectively; a,b,c differ $P<0.0001$) and the mouth moved more often ($55\%^a$, $37\%^b$ and $64\%^c$ of the time respectively; a,b,c differ $P<0.0001$) respectively. These results show that horses were more attentive to their riders even though they displayed more physiological and behavioural signs of stress during training compared to community and street environments, suggesting that the training appropriately prepares the police horses for situations they may encounter on duty, improving their overall welfare.

Assessing the play behaviour of fast-growing broilers reared in pens with or without enrichment

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Fast-growing broilers are at risk of developing welfare problems which may lead to negative affective states. Previous research suggests that offering suitable environmental enrichment to broilers could improve their welfare by reducing lameness and increasing mobility. However, the extent to which affective states of broilers can be improved by enrichment remains unclear. Play behaviour is often considered an indicator of welfare because its frequency is often reduced when animals are under biological challenge, and it is increasingly being used as an indicator of positive affective states. Our objective was to assess the play behaviour of broilers reared in enriched (E) or non-enriched (NE) pens. We housed 456 Ross 708 broiler chickens in 12 floor pens (38 birds/pen; 19 females and 19 males) from 1 day until 43 days of age. Each pen (1.68 x 2.29 m^2) was equipped with one feeder, nipple drinkers and wood shavings. E pens included a raised platform with a 25° ramp, a hanging scale, pecking stone and suet feeder filled with wood shavings. Two tests performed at the pen level were intended to stimulate play behaviour: giving extra space and offering objects suitable for worm running. The "extra space" tests conducted at day 8, 22 and 36 involved removing a feeder to create an area of unoccupied space. "Worm running" tests conducted at day 10, 25 and 39 involved throwing a "worm" made from twisted tissue paper into the pen. In both tests, video recordings were used to quantify behaviour for 5 minutes using continuous all-occurrence sampling. Generalized linear mixed models were used to evaluate effects of treatment, age and their interaction on play frequency/bird/5min. During "extra space" tests, total play behaviour (run, wing-assisted run, wing-flap, play-fight) decreased as chickens aged, but there was a treatment × age interaction ($P<0.001$). On day 8, the frequency of play behaviour was higher in NE (Least Squares Mean±SD: 3.47±0.25) than E pens (0.87±0.25; $P<0.001$) whereas the difference was non-significant on day 22 (NE: 2.04±0.25; E: 0.99±0.25) and day 36 (NE: 0.48±0.25; E: 0.51±0.25). During the "worm running" tests, the total frequencies of worm chase ($P<0.001$), worm run ($P=0.035$) and worm exchange ($P=0.034$) were higher in NE (3.20±0.16, 1.02±0.05, and 0.40±0.04, respectively) than E pens (1.92±0.16, 0.85±0.53 and 0.28±0.04, respectively). Our findings indicate that NE birds played more than E birds during tests intended to stimulate play behaviour. The larger contrast between the NE environment before and after giving the test stimuli (i.e. opening up extra space and offering "worms") compared to that in the E pens may have led the NE birds to be more easily stimulated to play during the tests. According to this interpretation, the higher play behaviour in the NE birds reflected transiently higher responsiveness in the test context rather than reflecting an underlying state of greater positive welfare when kept in a NE environment.

Are "depression-like" responses in mice really depression?

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Standard housing (SH) for laboratory mice comprises barren, shoebox-sized cages. These conditions restrict highly motivated behaviours, such as exploring, socializing or taking cover, and as a result often induce stereotypic behaviours like continuously running in circles or mouthing cage bars. But in SH conditions some mice instead spend excessive time simply standing motionless with eyes open, inactive-but-awake (IBA). Several studies have shown that IBA is more common in SH than in complex, welfare-friendly, enriched housing (EH), and one has shown IBA predicts increased time floating immobile in Forced Swim Tests (FST): a measure of 'learned helplessness' often used in rodent-based depression research. Therefore, IBA has good potential as an indicator of poor mouse welfare. Furthermore, since IBA is linked to the depressive symptom "helplessness", this excessive inactivity might resemble the reduced activity often observed in depressed humans and indicate depression-like states in mice. However, depression is a complex disorder that cannot be diagnosed by the presence of a single trait; thus current evidence is not sufficient to conclude that SH induces depression-like states in IBA mice. To more fully test this hypothesis, we reared female mice (n=132) from three strains (C57BL/6, DBA, BALB/c) to adulthood in SH or EH. Home cage behavioural observations were conducted via live scan sampling when mice were 3, 5, 8 and 10 months of age. FSTs were then conducted to assess helplessness by placing mice in a cylinder of gently warmed water, allowing a 2-minute habituation period, then recording time spent immobile during the subsequent 4-minute test period. Data were analyzed using general linear mixed models or Wilcoxon rank-sum tests. We first replicated the finding that levels of IBA are higher in SH mice, with significant effects in C57BL/6 and BALB/c ($P<0.0001$) strains. During FSTs, levels of immobility were also higher in SH than EH mice, with significant effects in C57BL/6 ($P=0.0005$) and BALB/c ($P=0.003$) strains; and IBA significantly predicted FST floating in SH mice ($P=0.02$). However, mice were also weighed, and body length measured to assess body mass indices (BMI); and controlling for BMI reduced the relationship between IBA and FST floating to a trend ($P=0.07$). We then extended this research to two other diagnostic criteria of depression: changes in weight and sleep patterns, predicting higher body mass indices (BMI), and more time spent sleeping if IBA mice are depressed. High levels of IBA significantly predicted higher BMI across all strains ($P=0.003$) and increased sleep during the active phase in DBA ($P=0.0001$) and SH BALB/c mice ($P<0.0001$). Taken together, IBA is thus increased by sub-optimal housing, and linked with multiple depressive symptoms. This adds further support to the hypothesis that SH induces depression in IBA mice, although alternative hypotheses have yet to be tested.

Modulation of tryptophan metabolism and feather pecking by probiotic bacteria in laying hens

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Feather pecking (FP) occurs when laying hens peck repetitively at the plumage of conspecifics. It can cause poor feather cover, injuries and lead to cannibalism making it a major welfare issue. FP can be triggered by stress and is associated with altered serotonin neurotransmission. Serotonin is a neurotransmitter produced via the breakdown of the essential amino-acid tryptophan (TRP). However, this is only a minor pathway in TRP breakdown, as the majority of TRP, after protein synthesis, is converted into kynurenine (KYN). TRP metabolism can be modulated by lactic bacteria in mammals, where specific *Lactobacillus* bacteria also show positive effects on anti-social and stress-induced anxiety-like behaviours. However, it is unknown if the same effect would be observed in birds. Furthermore, birds with a high tendency for FP have less *Lactobaccillacae* in their gut compared to non-peckers. Our objective was therefore to examine the impact of a probiotic *Lactobacillus* bacteria supplementation on plasma TRP and KYN concentrations and subsequent FP behaviour in hens. White leghorn hens (19 weeks of age) were assigned to 6 probiotic (PRO) or 6 placebo groups (PLA) (7±1 birds/group; 86 birds total). For 5 weeks, PRO birds orally received $5*10^9$ *Lactobacillus* strain dissolved in 1 mL water and PLA birds received 1 mL water through the same procedure everyday. Behaviour was video-recorded before treatment (3-day baseline) and throughout treatment (9 days) and all occurrences of severe FP (SFP) recorded. Blood samples were collected before and after treatment to determine plasma TRP and KYN concentrations. A generalized linear mixed model for repeated measures was used to investigate effects of supplementation and time on TRP, KYN and SFP using bodyweight as a covariate and bird as the experimental unit. TRP decreased over time in both groups but TRP breakdown to KYN was less pronounced in PRO birds ($P<0.05$). A higher proportion of birds were classified as severe peckers in PRO compared to PLA birds ($P=0.05$), likely due to a numerically higher proportion of these birds already observed in the PRO group at baseline. However, despite this finding the amount of SFP bouts ($P=0.37$) and the proportion of severe peckers ($P=0.34$) did not increase over the 5 weeks. These results indicate that the probiotic can modulate TRP metabolism by decreasing the KYN pathway, which could leave increased TRP availability for serotonin production. This may explain the countering of the expected spread of SFP within the PRO groups. Further research is needed to assess the effectiveness *Lactobacillus* supplementation in reducing FP under commercial conditions, however, if proven successful this could improve laying hen welfare.

How excreta and ammonia reductant application affect turkeys' perceived value of wood shavings

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Standard farms house turkeys on floors covered with bedding material (commonly pine wood shavings). As the turkeys age, feathers, waste feed, and excreta accrue in the bedding, which will be unchanged at least until birds go to slaughter. How this soiling impacts turkey welfare or alters the perceived value of litter to turkeys is unknown. This study aimed to assess turkeys' relative preference for different litter management practices through a consumer-demand approach. Twenty-four 11-week-old turkey hens raised on wood shavings were housed in 6 pens (4 birds/pen) with a 'home' (H) and 'treatment' (T) compartment separated by a barrier with two unidirectional push-doors. We determined the hens' relative preference for wood shavings in H (unchanged throughout the experiment) by comparing it to one of four substrates in T: unsoiled wood shavings (US), other soiled wood shavings (SS), soiled wood shavings treated with an ammonia reductant (AS), and no litter (concrete floors covered in rubber mats, NL). Furthermore, we compared the hens' relative preference for all of these substrates to their motivation to access feed. To do so, we blocked the feeder in H and placed soiled shavings in T, forcing birds to obtain feed in the T compartment (treatment F). To quantify the hens' motivation to enter the treatments, the door that led to T randomly weighed 0, 20 or 40% of the hens' average weight, while T and H switched sides with each treatment/door weight combination. We collected data on bird location (in T or H) via video-recordings using instantaneous scan sampling every 30 min for an average of 14 hours per combination. We analyzed the effect of treatment, door weight, and their interaction on the percentage of time birds spent in T using a generalized linear mixed model (PROC GLIMMIX, SAS V9.4). Door weight did not have a significant effect on where turkeys spent their time (P>0.05). Turkeys spent significantly more time in T in the presence of F (64%±9.0%, P<0.001) than with US (21%±13.3%), AS (24%±12.9%), or NL (20%±13.1%), while they spent the same amount of time in T with SS (45%±10.8%). To the authors' knowledge, we present the first motivational test to evaluate how excreta and ammonia reductant application modifies the perceived value of wood shavings to turkeys. In conclusion, turkeys spent the same amount of time in T when SS or F treatments were present, while they displayed a lower relative preference for US, AS, and NL. It is possible that SS was less soiled compared to H litter, which may influence the turkeys' preference. Alternatively, SS may possess properties that attract turkeys (e.g. more diverse litter to forage in); however, this requires further investigation.

The influence of enrichment on leg parameters in a conventional strain of broiler chicken

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The association among high body weight, low activity, and leg disorders causing lameness has been well studied in commercial broiler chickens raised in standard environments. In addition to the economic implications, lameness is a significant welfare concern as it is associated with pain. Therefore, several strategies have been proposed to decrease the incidence of leg disorders in commercial broiler chickens, including the addition of enrichment. Enrichments may increase activity level and locomotion in chickens, especially in earlier stages of growth. However, the impacts of enrichment on leg disorders (as evaluated by morphology and bone quality) is unclear. The objective of this study was to evaluate the impact of an enriched environment on tibial dimensions, ash content, bone breaking strength and tibia dyschondroplasia in a commercial strain of broiler chickens raised indoors. The enriched material consisted of an elevated platform (30 cm above the litter, attached to a 25° ramp), a mineral pecking stone, shredded nylon rope, and automated hanging scale. A total of 456 male Ross 708 birds were equally distributed in 12 pens (38 birds per pen, 30kg/m^2), divided into 2 treatments: enriched environment (n=6) and control without enrichment (n=6). On day 43, 4 birds per pen were selected based on body weight (one low, two average, and one high). The birds were euthanized by cervical dislocation and both left and right tibia were removed and dimensions (length and diameter) were obtained. The left tibia was used to estimate dry matter content and bone ash concentration (%) as an indicator of bone mineralization. The right tibia was used to evaluate tibia breaking strength using Instron testing machine, followed by the assessment of tibial dyschondroplasia. Data were analyzed as a randomized complete block design with treatment (enriched and non-enriched) as main factors and final body weight as a covariate using Proc Glimmix in SAS. The enrichment materials provided did not alter tibia length (P=0.38), tibia diameter (P=0.84), tibia dry weight (P=0.71), tibia ash content (P=0.57) or tibia breaking strength (P=0.29). None of the tibiae from either treatment exhibited tibia dyschondroplasia. Similar tibial morphometric and bone quality indicators have been reported in previous studies, indicating that the values found in our study were within normal range for commercial broiler chickens. Walking ability and leg strength were assessed as part of another study with these birds, in which no difference was found between the treatments, supporting the findings of our study. We suggest that the low levels of activity in modern strains of broiler chickens reduces the ability of the chosen enrichments to improve leg heath. Furthermore, other types of enrichment should be studied for broiler chickens raised indoors to determine their ability for improving locomotor activity and leg health.

Risk factors for aggression in adult cats that were fostered through a shelter program as kittens

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Aggressive behaviour in cats is a threat to human and animal safety and can also impact cat welfare if breakdown of the human-animal bond leads to neglect, relinquishment or euthanasia. The influence of early and ongoing management factors on cat aggression was examined for cats aged 1 to 6 years that were adopted following shelter fostering as kittens (N=262). Early management details were extracted from shelter records, and adoptive owners completed an online survey concerning the frequency and severity of fear and aggression, owner demographics, home environment, and training methods. Factor analysis on fear and aggression questions identified five outcome variables for further analysis using logistic regression. The odds of aggression towards the owner were significantly greater in female cats (OR=1.754, P=0.049), and lower in households with three or more cats (OR=0.192, P=<0.001), or when owners reported using positive reinforcement (OR=0.280, P=0.002). Furthermore, the odds of severe aggression towards people were significantly greater when the owner reported using various forms of positive punishment (i.e., making a loud noise, verbal correction, holding the cat) and lower when there were three or more cats in the household (OR=0.307, P=0.016). The odds of aggression towards other cats were increased in female cats (OR=2.377, P=0.004), in cats with equal indoor/outdoor access compared those without outdoor access (OR=4.885, P=0.017), and in cats that were owner surrendered as compared to stray kittens (OR=2.209, P=0.031). Lastly, the odds of severe aggression towards other animals were significantly increased when the owner indicated there were other pets, of any type, living in the household (OR=2.655, P=0.002) and when owners reported using positive punishment (i.e., verbal correction) (OR=3.517, P=0.006), and lower when provided with training enrichment (OR=0.280, P=0.034). Increased animal-directed aggression with other pets in the household likely corresponds with increased opportunity, although owners reporting 'no opportunity to observe' resulted in removal from the analysis. Surprisingly, we did not find any associations between aggression and management factors related to early social exposure that have been anecdotally suggested to influence aggression (e.g., bottle-reared, singleton, early rehoming age), possibly via increased fearfulness. Thus, while mother-rearing was associated with aggression during exposure to novelty, other factors associated with the various forms of aggression were related to the adoptive home environment and training methods. These results highlight several potential areas for future research, and for owner education to reduce cat aggression, particularly for kittens acquired through shelter-run fostering programs.

Behavioural and physiological effects of prenatal stress in different genetic lines of laying hens

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Prenatal stress can have long-lasting effects on the behaviour and physiology of a hen. Stress vulnerability can be impacted by genetics, resulting in different responses across strains. We hypothesized that offspring response to prenatal stress will depend on the genetics of the breeder flock. For this, two stress models (Natural and Pharmacological) were tested in five genetic lines of breeder hens: two commercial brown (B1 & B2), two commercial white (W1 & W2) and a Pure Line White Leghorn (WL). To form the Parent Stock, fertilized eggs were incubated, hatched and housed identically in 4 flocks of 27 birds (24F:3M) per strain. Each strain was equally separated into two groups: "Stress", where hens were subjected to a series of acute psychological stressors (e.g. physical restraint, transportation) for eight days before egg collection, and "Control", which received routine husbandry. At three maternal ages, fertile eggs from both treatments were collected and additional eggs from Control were injected with corticosterone (10 ng/mL egg content) ("CORT"). A "Vehicle" treatment was included to account for effects of egg manipulation. Each maternal age comprised a replicate over time. Eggs were incubated, hatched, and offspring (N=1919) brooded until 17 weeks (wks) under identical conditions. Animal use was approved by the University of Guelph Animal Care Committee. Behavioural analyses included tonic immobility at 9 wks (N=450) and a combined voluntary human approach (N=140) and novel object test (N=180) at 16 wks. HPA-axis response and recovery were measured at 13 wks (N=640), through analyses of plasma corticosterone concentration in baseline samples and after 10 and 20 minutes of physical restraint. The effects of the stress model, genetic line, sex and the interaction between stress model and genetic line were subjected to ANOVA using the Glimmix procedure in SAS. Random effects included pen, room and maternal age. Further pre-planned comparisons included stress model (Control vs Stress; Control vs CORT) and strain (brown vs white). Prenatal stress did not affect any of the traits measured ($P>0.105$). Baseline levels of corticosterone did not differ among strains ($P>0.066$), but white lines showed higher HPA-axis responsiveness ($P<0.013$) and slower recovery ($P<0.009$) than brown. Brown birds stayed longer in tonic immobility ($P<0.001$) and B2 spent less time close to human than W1 ($P=0.001$) in the human approach test. Interestingly, time spent close to the novel object did not vary between W1, B1 and B2 ($P>0.220$). Results suggest that the white lines used in this study are more responsive but less fearful than the brown lines. Moreover, brown hens seem to respond differently to humans and objects, being more afraid of the former. Although our original hypothesis was rejected, this study highlighted the variety of behavioural and physiological responses across different genetic lines of laying hens.

Commercial aviary rearing systems and their effect on locomotory behaviour in pullets

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The Canadian egg industry is transitioning from conventional cages to enriched cages, and non-cage housing in aviaries. Aviaries are complex three-dimensional environments, requiring hens to locate resources on vertical tiers. If young hens (pullets) do not learn to navigate the aviary or do not develop sufficient muscle and bone strength during rearing through loading exercises, they will be at higher risk of starvation and dehydration as a consequence of not being able to find or reach critical resources. Weak bones and inability to navigate aviaries may result in painful fractures from collisions into the system or other birds. Thus pullets destined for aviaries should be raised in a similarly complex rearing system to teach them navigational skills through a variety of locomotory behaviours. However, there are multiple styles of aviary rearing systems available to producers. Pullets reared in Styles 1 and 2 are placed in cages. Style 1 is outfitted with two low perches; Style 2 has an additional platform and multiple higher perches providing chicks vertical space. When pullets are ~4 weeks old the doors are opened, into an aisle with terraces, perches, and a litter floor. Style 3 is an open concept system, allowing pullets access to multiple elevated perches and platforms at placement spanning almost the length of the barn. The side of the system is opened to a litter floor at ~6 weeks. This study aims to determine which locomotory behaviours pullets perform during rearing in these three commercial rearing systems. We hypothesize that birds housed in Style 3, younger birds, and white birds will perform the most high energy behaviours. We followed 15 flocks throughout rearing from 11 commercial farms. Flocks were visited three times at ~4, 10, and 16 weeks of age. Cameras were set up to capture behaviours performed both within the system and on the litter. Video recordings lasted two hours and were taken at three time-points throughout the day: just after lights on, the middle of the light period, and before lights off. Noldus Observer software will be used to analyze behaviour according to a predetermined ethogram. Thirty minutes will be analyzed from each video in six observation periods of five minutes. Observers will follow 10 focal birds from predetermined locations, each for 30 seconds during every observation period (60 birds/ video). Locomotory behaviours and the location where they are performed (e.g. litter, platform, perch) will be recorded. Differences between styles are expected in the frequency and duration of high-energy activities such as wing flapping, running, and aerial locomotion. Style 3 is expected to have the highest and Style 1 the lowest occurrence of such behaviours. White strains are expected to be more active than brown strains regardless of housing. Results from this study will provide producers with further insight into which style of pullet housing would best prepare their hens for life in a complex adult aviary.

Risk factors of competitive tendencies and fearfulness in puppies

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Canine aggression is a serious threat to canine welfare. Aggressive behaviour can lead to owner frustration and fear, causing altered behaviour (withholding attention or employing positive punishment), weakening the human-animal bond and negatively impacting the dog's welfare. Furthermore, aggressive dogs are at higher risk for euthanasia and relinquishment. Two common types of canine aggression are resource guarding, characterized by attempts to control access to items that the dog considers valuable and can be directed towards people or other dogs, and stranger-directed aggression, threats and aggression directed towards unfamiliar people. It is well documented that experiences during early development can drastically influence behaviour later in life. Preliminary research suggests a potential link between fearfulness in puppies and subsequent development of stranger-directed aggression. It is also possible that competitive tendencies in puppies might predispose dogs to resource guarding. The objective of this research is to determine whether various dog-related (e.g. breed, sex, individual temperament) and management-related (e.g. socialization, training, feeding, play facilitation) factors are associated with the development of competitive and fear behaviours in juvenile dogs. Based on a predicted prevalence of 10%, a sample size of 750 puppies (150 litters with an average litter size of 5) was calculated. Six breeds with a high prevalence of these behaviours (Dachshunds, Cocker Spaniels, German Shepherds, Chihuahuas, Boxers and Rottweilers) will be used in a prospective cohort study following them from birth to six months of age. Surveys will be distributed to breeders upon enrollment to obtain breeder demographics, standard management practices, feeding and training protocols. To assess early competitive tendencies, breeders will be asked to video-record three nursing bouts (2-4 woa) and three feeding bouts at the food bowl (3-6 woa), as well as littermate interaction around a play object introduced to the group (5-7 woa). Fearfulness will be documented from video recordings of exposure to three novel stimuli (e.g. people, objects, noises) (5-7 woa) as well as each puppy's response to a mock physical exam completed by the breeder (7 woa). Lastly, once dogs have been placed in a home, surveys will be sent out to owners at 16-weeks and 6 months of age to evaluate owner demographics, management, feeding, training protocols and the prevalence of competitive and fear behaviours. Logistic and linear regression models will be built to assess which management and dog-related factors increase a dog's risk of developing these behavioural problems. The results from this project will determine how to best manage, train and socialize puppies while they are still with the breeder. This research will benefit breeders, owners and dogs as it aims to prevent the development of resource guarding and stranger-directed aggression in companion dogs.

Efficacy of pain control for caustic paste disbudding in very young calves

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Disbudding is a common procedure practiced in the dairy industry and is well known to cause significant pain when performed without proper pain control. Dairy producers disbudding calves with caustic paste are less likely to provide pain control than those using cautery. Little research has been conducted on pain control for caustic paste disbudding and no studies have specifically examined calves under a week of age although producers will commonly apply caustic paste at this time. The objective of this study was to evaluate the efficacy of local anesthesia and nonsteroidal anti-inflammatory drug (NSAID) analgesia on indicators of pain and inflammation in dairy calves in their first week of life. One hundred and forty heifer calves aged 1-9 d were enrolled into 28 blocks and randomly allocated to 1 of 5 treatments: sham control; positive control (no pain control); lidocaine cornual block; meloxicam; and lidocaine cornual block and meloxicam. Outcomes collected include serum cortisol, serum haptoglobin, and pressure sensitivity. Samples for cortisol were taken at -25, 0, 15, 30, 45, 60, 90, 120 and 180 min relative to disbudding as cortisol is released during an acute stress response. Samples for haptoglobin were taken at -25, 0, 60, 90, 120, 180 min, 3-4 d and 6-7 d relative to disbudding as haptoglobin is released more slowly during an inflammatory response. Measurements for pressure sensitivity were taken at -25, 0, 60, 90, 120, 180 min, 3-4 d and 6-7 d relative to disbudding. Data were analyzed using mixed models with treatment as a fixed effect, baseline values for each measure as a covariate and trial block as a random effect. Compared to the positive control group, lidocaine/meloxicam reduced serum cortisol at 15, 30, 45, and 60 min post-disbudding (60 min; -138 pg/ml, 95% CI -200 to -76 pg/mL). Cortisol values were not different between lidocaine and lidocaine/meloxicam treated calves and sham controls at these time points. At 60, 90, 120, and 180 min post-disbudding, calves treated with lidocaine/meloxicam had reduced cortisol compared to lidocaine alone (180 min post disbudding, -61 pg/mL, 95% CI -112 to -10 pg/mL), and values did not differ between lidocaine/meloxicam treated calves and sham controls at these time points. At 3-4 d post-disbudding, treatment with lidocaine and meloxicam tended to reduce haptoglobin (+0.16 mg/mL, 95% CI 0.00 to 0.32), but no differences were found between groups at 180 min and 6-7 d post-disbudding. At 60, 90, and 120 min post-disbudding, lidocaine and lidocaine/meloxicam treated calves had decreased pressure sensitivity compared to other groups (90 min, -2.26 kgf, 95% CI -3.15 to -1.37). No differences were seen in pressure sensitivity between groups at 180 min, 3-4- or 6-7-d post-disbudding. These findings suggest that the combination of local anesthesia with NSAID analgesia are beneficial for reducing pain indicators and inflammation in very young calves disbudded with caustic paste.

Early environmental effects on laying hen's behavioural, cognitive and musculoskeletal development

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In 2016, Egg Farmers of Canada decided to improve laying hen welfare by transitioning from conventional cages to enriched or cage free housings. Laying hens housed in cage free systems, while experiencing numerous benefits, also deal with many challenges; be it social life in large flock sizes, an increased risk of injury due to crashes and collisions, or the high demand for spatial navigation skills to reach the different resources. To cope with these challenges, birds need to be raised in similarly complex rearing systems to develop the necessary skill set. In laying hens, the rearing period lasts for 16 weeks with birds being enclosed within the system for the first 3-6 weeks, after which they are given access to a litter area, additional platforms, ramps and perches. This study compares the effects of three increasingly complex rearing aviaries with increasing tree-dimensional space on the development of behavioural, cognitive, and musculoskeletal traits in brown and white egg laying hybrids. We hypothesize that more complex rearing environments will increase a pullet's ability to navigate spatial tasks, decrease fearfulness, strengthen bones, and increase muscle mass. Four replicate flocks will be raised per aviary design and laying hen hybrid, and subsets of pullets will be assessed on physical, cognitive, and behavioural characteristics at 6 and/or 16 weeks of age (WoA). To assess physical abilities, pullets will have to jump over different height barriers or use ramps to reach a social reward in form of conspecifics (6 WoA) and by letting them reach food rewards on platforms arranged with different complexity to access (16 WoA). Fearfulness will be estimated with a novel object test, and startle response will be estimated with a force plate measuring the reaction to a startling light flash at both ages. Spatial cognition will be measured at 16 WoA by analysing the learning curve navigating a T-maze, and dissections will be performed at 5 and 16 WoA to assess bone strength and muscle weight. Activity will be monitored by fastening activity monitors on backpacks for several days during the first 6 weeks and every other week after that. At the same time, space use will be tracked with a novel method for chickens by using QR (Quick Response) codes on their back and tracking their movements with video and photo cameras. The QR code acts as a two-dimensional barcode, encrypting a unique number each to identify individuals. We expect to see best physical and navigation performances in pullets raised in the most complex system, where we anticipate a high level of activity as birds use the offered space. The increased activity is predicted to lead to increased bone strength and muscle mass. We further expect those pullets to be least fearful in the novel object test with the smallest startle reaction. Combined, the results of before-mentioned tests ought to enable us to give evidence-based recommendation for farmers and other stakeholders concerning laying hen pullet rearing for cage free housing systems.

The effect of enrichment on organ growth, cardiac myopathies, and bursal atrophy in a conventional strain of broiler chicken

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One by-product of fast growth in conventional broiler chickens is a mismatch in nutrient allocation, resulting in reduced organ growth compared to body weight, which may lead to poor health and reduced activity, which are major welfare concerns. Although the connection between exercise and health in avian species has not been well studied, the link has been made in various other farmed animal species. The objective of this study was to determine if broiler cardiovascular and immune health, as well as organ growth, can be improved with the provision of enrichments that offer different opportunities for exercise. There were 12 pens in total, with half including enrichments (E; n=6), and half with no enrichment as a control (NE; n=6). A total of 456 Ross 708 male broilers were used and randomly allocated to each pen (38 birds/pen; 30kg/m^2) at 1 d of age. Enriched pens had a 25° ramp to a raised platform (30 cm above litter), and a hanging round scale. Both objects encouraged birds to walk and climb. Additionally, a suet feeder with wood shavings was used to encourage oral and locomotor behaviour. On D43, 4 birds per pen were selected based on body weight (1 heavy, 2 average, 1 light), and euthanized via cervical dislocation. Carcasses were dissected and the heart, lungs, liver, kidneys, and bursa of fabricius were weighed. Ventricles were separated, and weighed to determine the right ventricle to total ventricle (RV:TV) weight ratio. Data were analyzed as a complete randomized block design with treatment (E vs NE) as a fixed effect using Proc Glimmix in SAS 9.4, with final BW as a covariate. BW did not differ between treatments. There was a trend (P=0.051) for NE birds (0.38%, SEM±0.008) to have heavier heart weights, as a percentage of BW, than E (0.35%, SEM±0.009). No other variables were influenced by enrichment. Of all the sampled birds, 40.6% had abnormal RV:TV ratios, falling outside the healthy range (0.14<healthy<0.24), suggesting subclinical heart disease, and 14.1% had some degree of bursal atrophy (healthy>0.11). In conclusion, the enrichment used in this trial had minimal to no effect on organ growth, cardiac myopathies and bursal atrophy. A large proportion of the broilers sampled from both treatments had signs of impaired cardiovascular and immune functioning, which is a concern in conventional broiler production due to genetic selection for muscle growth.

Risk-factors associated with veterinary-related fear and aggression in owned domestic dogs

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Fear and aggression in dogs within veterinary clinics can lead to canine welfare impairments and pose a safety concern for veterinary staff. However, few studies have explored potential underlying causes for this fear and aggression, such as previous negative experiences in the clinic environment, or strategies for prevention, such as early exposure to veterinary environments and handling. We used an online cross-sectional survey targeted to current dog owners to examine risk factors associated with fear and aggression within veterinary clinics. To identify fear and aggression scores during veterinary visits, dog owners were asked to rate their dog's level of fear and aggression on a continuous scale from 0 to 4 (0=No fear/aggression, 1-3=Mild to moderate fear/aggression, 4=Severe fear/aggression) in response to 14 different situations relevant to veterinary visits. The factors we assessed related to dog characteristics (e.g., sex, breed), fear and aggression responses in every day scenarios (e.g., stranger-directed fear), experiences at the veterinary clinic (e.g., frequency of visits), training, socialization, and owner demographics (e.g., gender, age). Data were analyzed using mixed linear regression models, with participant ID as a random effect to account for multiple dogs within the same household. For fear within veterinary clinics, dogs (n=1,346) were more likely to be rated as fearful by their owners if they were neutered when they 1 year old or younger, if they received their first nail trim at an older age, if they were rated as having elevated non-social fear or stranger-directed fear and aggression, if they are fearful or aggressive when their body is handled, had a negative change in behaviour after an aversive experience, and if owners indicated being nervous in regard to situations within the veterinary clinic. For aggression with veterinary clinics, dogs (n=1,785) were more likely to be rated as aggressive by their owners if they are fearful of their feet being toweled, are fearful or aggressive when their body is handled, had examination shortened, received towel restraint and muzzling, received positive punishment training techniques routinely and within the clinic environment, and if the owner indicated being nervous in regards to situations within the veterinary clinic. Random effects for ID were significant for both fear and aggression models, with ICCs of 0.36 (CI: 0.2-0.54, P=0.0004) and 0.16 (CI: 0.06-0.36, P=0.017) respectively, indicating there were some correlation in behaviour amongst dogs owned by the same person. The results suggest that variables related to dog personality, previous early and veterinary clinic experiences, and owner experiences during veterinary visits are associated with fear and aggression within veterinary clinics. Results may be used to provide hypotheses for future research aimed at preventing the development of fear and aggression within a veterinary setting.

Optimizing pet rabbit care and welfare, and the owner-rabbit bond

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Rabbits are popular pets in many countries, but recent studies suggest that rates of relinquishment and rehoming are high. The main reasons for surrendering rabbits appear to be human-related and not rabbit-related, suggesting that the human-animal bond may be lacking, and that further research is needed to explore effective strategies for strengthening the human-animal bond. Research has shown that standard enclosures limit natural rabbit behaviours, plus these cages limit interactions with rabbit owners. We hypothesize that the human-animal bond can be enhanced through environmental and social enrichments that make rabbits more engaging pets, and propose epidemiology studies and animal welfare experiments to explore and test this hypothesis. Two cross-sectional, epidemiology surveys employing regression analysis will be used to identify and describe risk factors for pet rabbit welfare and owner attachment, and to assess associations between owner attachment and particular types of pet rabbit behaviours and owner interactions. The first owner survey (N = 2846) will answer the following research questions: What characteristics make rabbits attractive pets? Who considered giving their rabbit away and why? What factors are associated with owners playing with their rabbits and allowing out-of-cage time? Based on the first survey's results and key informant interviews, a new survey will be created. This second study will more fully identify and then quantify factors that make rabbits satisfying and engaging pets versus unsatisfying and unengaging pets. This international, online survey will rely on self-reported data from pet rabbit owners about their rabbits' behaviours and their interactions with them. Several key research questions will be answered. How integrated are the lives of strongly bonded versus less bonded owners? What are the rabbit and owner characteristics of house rabbits (i.e., rabbits kept free inside houses like house cats)? How do reported rabbit behaviours and the care provided to them differ in strongly bonded versus less bonded owners? Arising from the above research, controlled, pet rabbit experiments will be designed to assess the effect of key environmental and social interventions on rabbit behaviour and the human-animal bond. We predict that a large, enriched cage (an environmental intervention), and out-of-cage time combined with positive, rabbit-directed owner behaviours (an environmental and social intervention) will result in more highly motivated, natural rabbit behaviours and more owner interest, care and bond than a barren cage. This will be the first practical, science-based model of environmental and social interventions that could improve pet rabbit welfare and the welfare of people who choose to keep them as pets. These combined results may also provide a model for improving other small animal welfare and human-animal bonds.

The effect of omega-3 enriched maternal diets on social isolation vocalisations in ISA brown and Shaver white chicks

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In commercial poultry production fearfulness is a key issue, strong fear responses within flocks may lead to high mortality smothering events. Addition of long-chain polyunsaturated fatty acids such as omega-3s (n-3) into the diet of parental stock may alter the yolk composition of the hatching eggs produced. Developing embryos absorb ~ 95% of the phospholipid content of egg yolks. Increased n-3 in the yolk may alter brain development, specifically hippocampus, thereby altering fear responses. Previous research into n-3 enriched hatching eggs has found chicks with increased tonic immobility and novel environment reactions. The aim of this study was to explore whether social isolation (stressor) elicited different vocalisation (fear) responses between chicks hatched from mothers fed either n-3 enriched diets or a control diet. The chicks tested were part of a separate ongoing nutritional study using 2 strains, ISA brown and Shaver white, and 3 maternal diets. The n-3 enriched maternal diets, linseed (LinPro) and algae (All-G), were compared to a control diet. Social isolation tests were conducted at 4-6 days old, 108 chicks were tested (54 ISA, 54 Shaver). Six cages per maternal treatment were used with 1 chick randomly selected from each cage per day. Social isolation tests in chicks were validated as a pharmacological model for anxiety-like-states by Sufka et al., (Behavioural Pharmacology, 17:681-689, 2006). The chick was carried to the test room, placed in a lit padded box and the voice recording started. The test began when the researcher said "start", the timer set, and the lid placed. The test lasted 5 minutes. The voice recordings were inputted into WavePad software. Each recording was divided into distress periods (DP) lasting 30 seconds. The total number of vocalisations in each DP were counted, the vocalisations were also classified according to intensity (<18db, 18-12db, 12-6db, >6db). The data were analysed in R using ANOVA with maternal diet, DP and strain as fixed effects. This study found that offspring from n-3 fed mothers vocalised more frequently during social isolation than those from control fed mothers (χ^2=6.194, P=0.045). ISA browns vocalised more frequently than Shaver whites (χ^2=12.565, P<0.001), however there was no significant interaction between maternal diet and strain (χ^2=1.806, P=0.405). The number of vocalisations per DP differed significantly (χ^2=32.007, P<0.001). There was no significant difference between maternal treatments for vocalisation intensities <18db (χ^2=3.047, P=0.218), 18-12db (χ^2=0.307, P=0.858), or 12-16db (χ^2=1.341, P=0.511). However, those most likely to be distress vocalisations (>6db), showed a significant difference between maternal treatments (χ^2=7.376, P=0.025). This study shows that maternal fed n-3 affects the response of chicks to social isolation, increasing the frequency of distress vocalisations. These results are contiguous with previous research, suggesting that increased levels of n-3 available to developing embryos can influence fear response.