Livestock Emotions, Vocalisations and Positive Welfare

Dr. Alan McElligott, City University of Hong Kong

6th Africa Animal Welfare Conference. Oct 31-Nov 02, 2022.

https://www.alanmcelligott.co.uk/

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動物健康與福利中心
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CONTENTS

- **Five Freedoms, Five Domains, Positive Animal Welfare**
- **Goat Vocalisations and Welfare**
- **Chicken Vocalisations, Welfare and AI**

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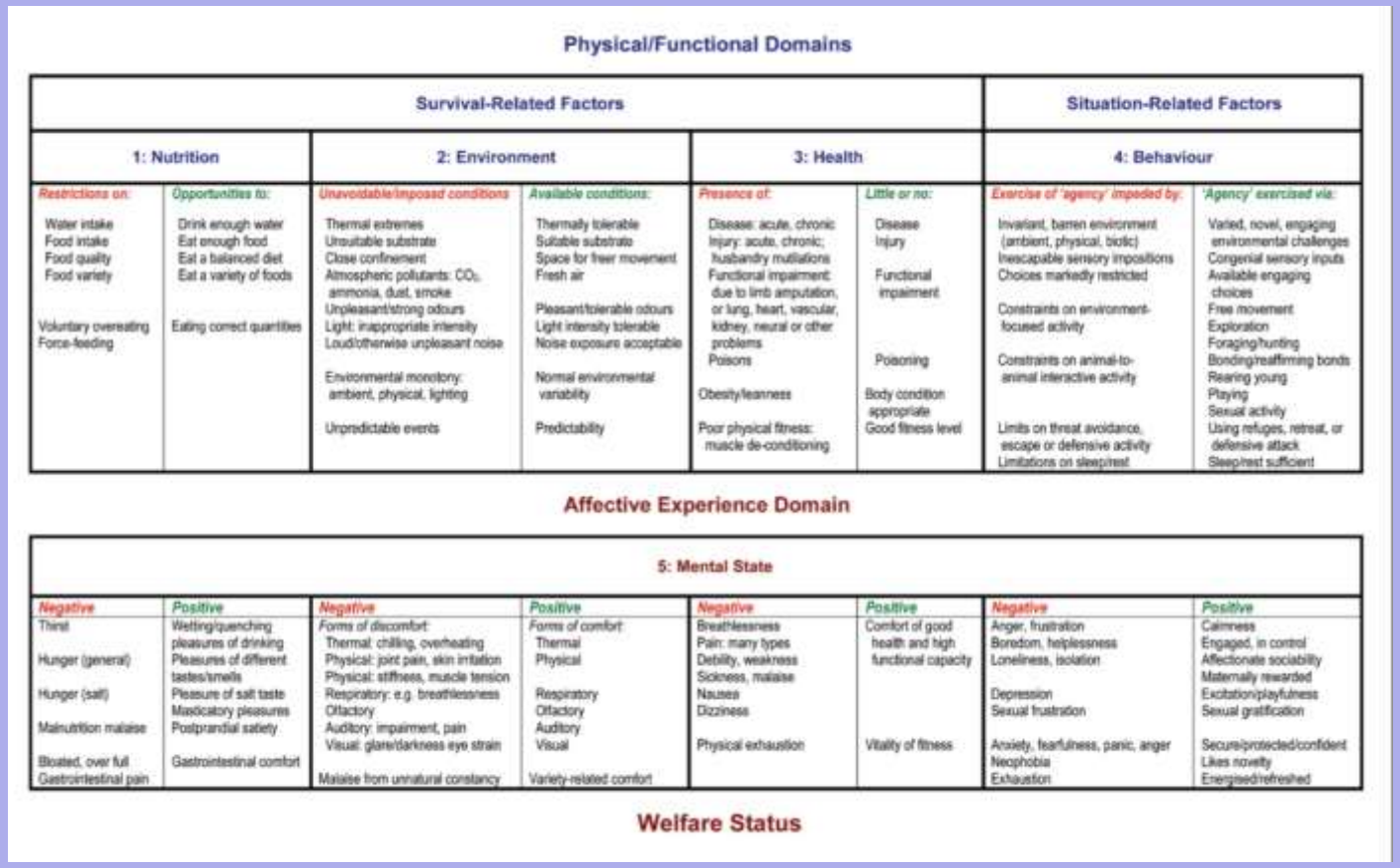
Animal Welfare – Five Freedoms

- 1. Freedom from Hunger and Thirst **(Nutrition)**
- 2. Freedom from Discomfort – shelter and comfortable resting area **(Environment)**
- 3. Freedom from Pain, Injury or Disease **(Health)**
- 4. Freedom to Express Normal Behaviour - sufficient space, proper facilities and company of the animal's own kind **(Behaviour)**
- 5. Freedom from Fear and Distress – avoid mental suffering **(Mental State)**

Developed in response to 1965 UK Government Brambell report on livestock husbandry, formalized in 1979.

Five Domains and Positive Animal Welfare

Mellor DJ, Beusoleil NJ (2015). Extending the Five Domains model for animal welfare assessment to incorporate positive welfare states. Animal Welfare 24, 241-253.



Physical/Functional Domains

Survival-Related Factors						Situation-Related Factors	
1: Nutrition		2: Environment		3: Health		4: Behaviour	
Restrictions on:	*Opportunities to:*	*Unavoidable/imposed conditions*	*Available conditions:*	*Presence of:*	*Little or no:*	*Exercise of 'agency' impeded by:*	*'Agency' exercised via:*
Water intake Food intake Food quality Food variety Voluntary overeating Force-feeding	Drink enough water Eat enough food Eat a balanced diet Eat a variety of foods Eating correct quantities	Thermal extremes Unsuitable substrate Close confinement Atmospheric pollutants: CO_2, ammonia, dust, smoke Unpleasant/strong odours Light: inappropriate intensity Loud/otherwise unpleasant noise Environmental monotony: ambient, physical, lighting Unpredictable events	Thermally tolerable Suitable substrate Space for freer movement Fresh air Pleasant/tolerable odours Light intensity tolerable Noise exposure acceptable Normal environmental variability Predictability	Disease: acute, chronic Injury: acute, chronic; husbandry mutilations Functional impairment: due to limb amputation, or lung, heart, vascular, kidney, neural or other problems Poisons Obesity/leanness Poor physical fitness: muscle de-conditioning	Disease Injury Functional impairment Poisoning Body condition appropriate Good fitness level	Invariant, barren environment (ambient, physical, biotic) Inescapable sensory impositions Choices markedly restricted Constraints on environment-focused activity Constraints on animal-to-animal interactive activity Limits on threat avoidance, escape or defensive activity Limitations on sleep/rest	Varied, novel, engaging environmental challenges Congenial sensory inputs Available engaging choices Free movement Exploration Foraging/hunting Bonding/reaffirming bonds Rearing young Playing Sexual activity Using refuges, retreat, or defensive attack Sleep/rest sufficient

Affective Experience Domain

5: Mental State							
Negative	*Positive*	*Negative*	*Positive*	*Negative*	*Positive*	*Negative*	*Positive*
Thirst Hunger (general) Hunger (salt) Malnutrition malaise Bloated, over full Gastrointestinal pain	Wetting/quenching pleasures of drinking Pleasures of different tastes/smells Pleasure of salt taste Masticatory pleasures Postprandial satiety Gastrointestinal comfort	*Forms of discomfort:* Thermal: chilling, overheating Physical: joint pain, skin irritation Physical: stiffness, muscle tension Respiratory: e.g. breathlessness Olfactory Auditory: impairment, pain Visual: glare/darkness eye strain Malaise from unnatural constancy	*Forms of comfort:* Thermal Physical Respiratory Olfactory Auditory Visual Variety-related comfort	Breathlessness Pain: many types Debility, weakness Sickness, malaise Nausea Dizziness Physical exhaustion	Comfort of good health and high functional capacity Vitality of fitness	Anger, frustration Boredom, helplessness Loneliness, isolation Depression Sexual frustration Anxiety, fearfulness, panic, anger Neophobia Exhaustion	Calmness Engaged, in control Affectionate sociability Maternally rewarded Excitation/playfulness Sexual gratification Secure/protected/confident Likes novelty Energised/refreshed

Welfare Status

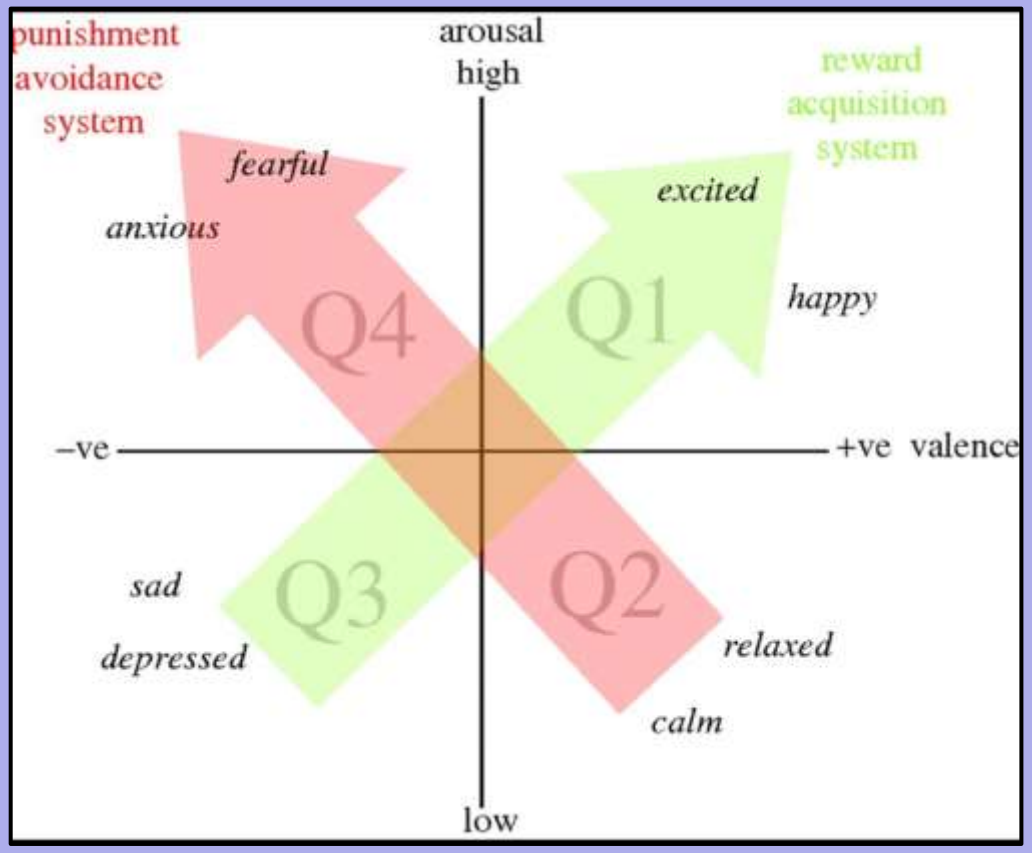
Animal Welfare *should not only be evaluated by the absence of negative states but also by the presence of* ***"Good Life"*** *or "****Positive Experiences****" enjoyed by animals.*

Positive Welfare, e.g. providing animals with opportunities to make their own decisions (agency), or to have positive social relationships.

Positive Animal Welfare and Emotions

Emotions - intense, short, affective reactions to information

Dimensional Approach



Components

- **Cognition** (e.g. learning, decision-making)
- **Behaviour** (e.g. movement, ear postures)
- **NeuroPhysiology** (Heart rate, HRV)
- **Subjective** (Humans)

(Russell 2003; Mendl et al. 2010)

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Goat Emotions: Expression and Perception

Treatments (N = 22 goats)

Four Treatments of different emotional Arousal and Valence:

- **Control** (eating hay – neutral)
- **Food Anticipation** (high arousal/positive)
- **Food Frustration** (low arousal/negative)
- **Isolation** (high arousal/negative)

Measured 23 different Physiological, Behavioural and Vocal Parameters

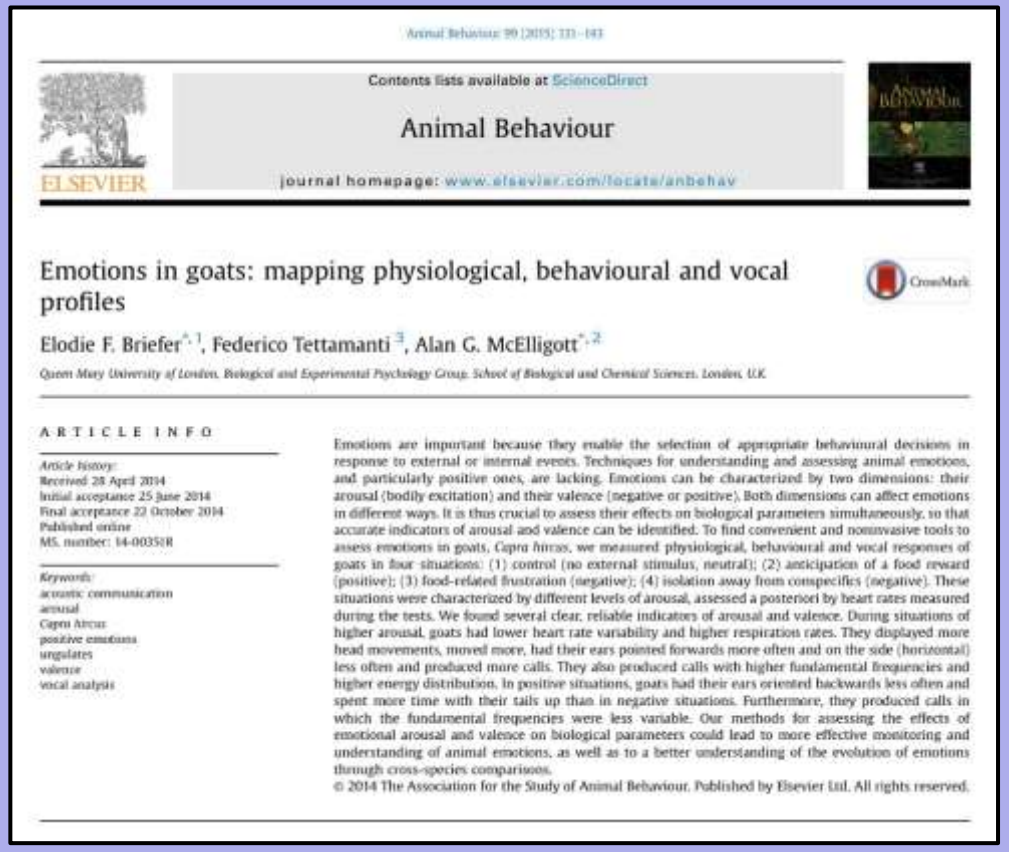
Briefer EF, Tettamanti F, McElligott AG (2015) Emotions in goats: mapping physiological, behavioural and vocal profiles. Animal Behaviour 99, 131-143.

Key Result

- **Pitch (Fundamental Frequency, F0) of Vocalisations More Stable in Positive Treatments versus Negative Treatments**

"Iceberg Indicator" of Animal Welfare

Goats and Emotion-linked Vocalisations



Animal Behaviour 99 (2015) 131–143

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Emotions in goats: mapping physiological, behavioural and vocal profiles

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Emotions are important because they enable the selection of appropriate behavioural decisions in response to external or internal events. Techniques for understanding and assessing animal emotions, and particularly positive ones, are lacking. Emotions can be characterized by two dimensions: their arousal (bodily excitation) and their valence (negative or positive). Both dimensions can affect emotions in different ways. It is thus crucial to assess their effects on biological parameters simultaneously, so that accurate indicators of arousal and valence can be identified. To find convenient and noninvasive tools to assess emotions in goats, *Capra hircus*, we measured physiological, behavioural and vocal responses of goats in four situations: (1) control (no external stimulus, neutral); (2) anticipation of a food reward (positive); (3) food-related frustration (negative); (4) isolation away from conspecifics (negative). These situations were characterized by different levels of arousal, assessed a posteriori by heart rates measured during the tests. We found several clear, reliable indicators of arousal and valence. During situations of higher arousal, goats had lower heart rate variability and higher respiration rates. They displayed more head movements, moved more, had their ears pointed forwards more often and on the side (horizontal) less often and produced more calls. They also produced calls with higher fundamental frequencies and higher energy distribution. In positive situations, goats had their ears oriented backwards less often and spent more time with their tails up than in negative situations. Furthermore, they produced calls in which the fundamental frequencies were less variable. Our methods for assessing the effects of emotional arousal and valence on biological parameters could lead to more effective monitoring and understanding of animal emotions, as well as to a better understanding of the evolution of emotions through cross-species comparisons.

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BuzzFeed

A 3-Step Guide To Knowing If Your Goat Is Happy

Scientists have looked into this important question. Here are their findings.

Kelly Oakes

Be one of the first to comment

Goats are clearly no strangers to happiness. Just look at these little chaps.

npr

Goats and Soda STORIES OF LIFE IN A CHANGING WORLD

How Can You Tell If Your Goat Is Happy? Now We Know!

Briefer EF, Tettamanti F, McElligott AG (2015) Emotions in goats: mapping physiological, behavioural and vocal profiles. Animal Behaviour 99, 131-143.

Goat Perception of Emotion-linked Vocalisations

Baciadonna et al. Frontiers in Zoology (2019) 16:25
https://doi.org/10.1186/s12983-019-0323-z

Frontiers in Zoology

RESEARCH Open Access

Goats distinguish between positive and negative emotion-linked vocalisations

Luigi Baciadonna[1*], Elodie F. Briefer[2,3*], Livio Favaro[3,4] and Alan G. McElligott[1,4*]

Abstract

Background: Evidence from humans suggests that the expression of emotions can regulate social interactions and promote coordination within a group. Despite its evolutionary importance, social communication of emotions in non-human animals is still not well understood. Here, we combine behavioural and physiological measures, to determine if animals can distinguish between vocalisations linked to different emotional valences (positive and negative). Using a playback paradigm, goats were habituated to listen to a conspecific call associated with positive or negative valence (habituation phase) and were subsequently exposed to a variant of the same call type (contact call) associated with the opposite valence (dishabituation phase), followed by a final call randomly selected from the habituation phase as control (rehabituation phase). The effects of the calls on the occurrence of looking and cardiac responses in these phases were recorded and compared.

Results: We found that when the valence of the call variant changed, goats were more likely to look at the source of the sound, indicating that they could distinguish calls based on their valence. Heart rate was not affected by the valence of the calls played, whereas heart-rate variability tended to be higher in the habituation and rehabituation phases, when positive calls were played compared to negative ones. Together, the behavioural and physiological measures provide evidence suggesting, first, that goats are able to distinguish call variants based on their valence, and second, that goat behaviour and cardiac responses are affected by call valence.

Conclusion: This study indicates that auditory modalities are a potent means to communicate emotions in non-human animals. These findings can contribute to our understanding of the evolution of emotion perception in non-human animals.

Keywords: Bioacoustics, Emotions, Heart-rate variability, Playback, Positive and negative valence, Ungulates

Goats are intelligent, social animals. A new study shows that they can differentiate between other goats' happiness or displeasure by listening to their voices.

ANIMALS

Goats can perceive each other's emotions from their voices

New research shows that goats can hear subtle emotional changes in (furthering our understanding about how animals perceive the world.

The Guardian

News Opinion Sport Culture Lifestyle

Animal behaviour

This article is more than 8 months old

Goats can distinguish emotions from each other's calls - study

Animals can distinguish between happy and sad calls and have different reactions

Baciadonna L, Briefer EF, Favaro L, McElligott AG (2019) Goats distinguish between positive and negative emotion-linked vocalisations. Frontiers in Zoology 16, 25.

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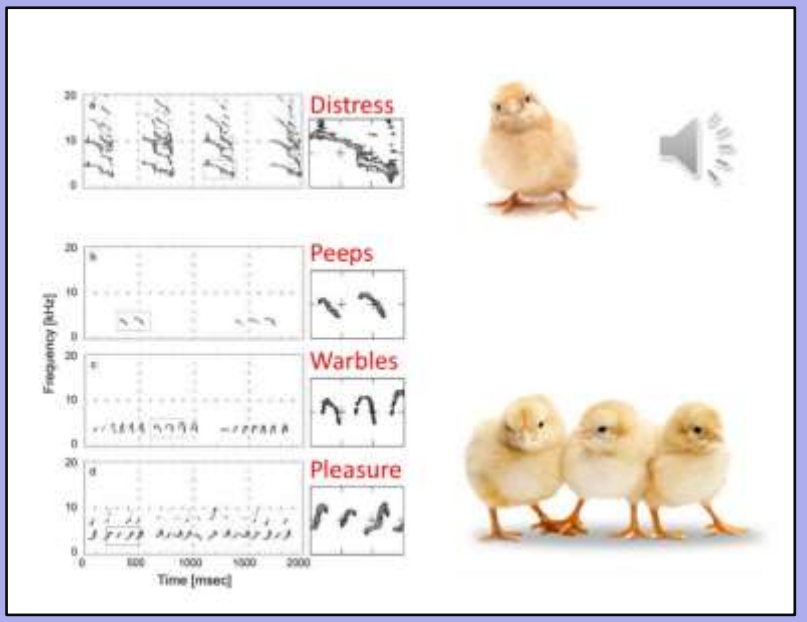
Broiler Chicken Vocalisations and Welfare (2015-2018, UK)



Recordings using 12 commercial sheds (25,000–27,000 chickens per shed)

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- **Spectral e** stic data, low values re white noise.

Herborn K, **McEl** for chicken welfare. Journal

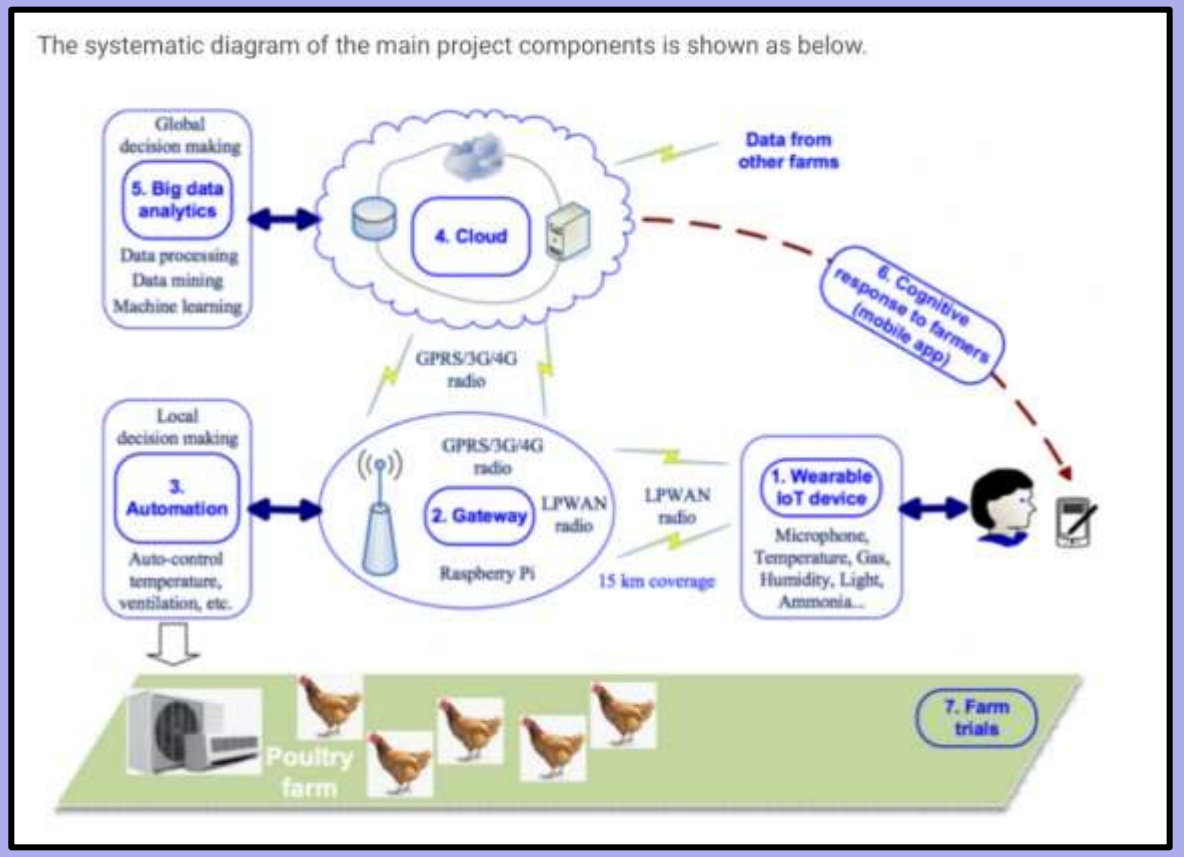
earth.com
NATURE · SCIENCE · LIFE

06-09-2020

Distress calls from baby chicks predict the health of the whole flock

By **Chrissy Sexton**
Earth.com staff writer

Chicken Vocalisations, Welfare and AI (2017-2019, China)



- Build an Automated monitoring system (Precision Livestock Farming) for identifying Chicken Distress Vocalisations.
- Guangxi Veterinary Research Institute
- Chickens in cages, 2000 – 2500 per shed

Chicken Vocalisations, Welfare and AI (2017-2019, CHINA)

INTERFACE

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Research

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Downloaded from https://royalsocietypublishing.org/ on 29 June 2022

Automated identification of chicken distress vocalizations using deep learning models

Axiu Mao[1], Claire S. E. Giraudet[1,2], Kai Liu[1,3], Inês De Almeida Nolasco[4], Zhiqin Xie[5], Zhixun Xie[5], Yue Gao[6], James Theobald[7], Devaki Bhatta[7], Rebecca Stewart[8] and Alan G. McElligott[1,2]

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The annual global production of chickens exceeds 25 billion birds, which are often housed in very large groups, numbering thousands. Distress calling triggered by various sources of stress has been suggested as an 'iceberg indicator' of chicken welfare. However, to date, the identification of distress calls largely relies on manual annotation, which is very labour-intensive and time-consuming. Thus, a novel convolutional neural network-based model, light-VGG11, was developed to automatically identify chicken distress calls using recordings (3363 distress calls and 1973 natural barn sounds) collected on an intensive farm. The light-VGG11 was modified from VGG11 with significantly fewer parameters (9.3 million versus 128 million) and 55.88% faster detection speed while displaying comparable performance, i.e. precision (94.56%), recall (94.89%), F1-score (94.73%) and accuracy (95.07%), therefore more useful for model deployment in practice. To additionally improve light-VGG11's performance, we investigated the impacts of different data augmentation techniques (i.e. time masking, frequency masking, mixed spectrograms of the same class and Gaussian noise) and found that they could improve distress calls detection by up to 1.52%. Our distress call detection demonstration on continuous audio recordings, shows the potential for developing technologies to monitor the output of this call type in large, commercial chicken flocks.

- Developed an algorithm to automatically identify chicken distress calls.
- Correctly identify 97% of distress calls, among other farm sounds.

MAO A, Giraudet CSE, LIU K, De Almeida Nolasco I, XIE Z, XIE Z, GAO Y, Theobald J, Bhatta R, Stewart R, McElligott AG (2022) Automated identification of chicken distress vocalisations using deep learning models. Journal of the Royal Society Interface 19, 20210921.

Chicken Vocalisations, Welfare and AI (2017-2019, CHINA)

Science

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Artificial intelligence could spot baby chickens in distress

Advance may one day help farmers better monitor the health and welfare of their flocks

28 JUN 2022 · 7:01 PM · BY VIRGINIA MORELL

NewScientist

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AI that detects chicken distress calls could improve farm conditions

A deep learning model can pick out chicken distress calls from recordings taken at commercial farms, and could be used to improve chicken welfare

LIFE 29 June 2022

By James Dinneen

MAO A, Giraudet CSE, LIU K, De Almeida Nolasco I, XIE Z, XIE Z, GAO Y, Theobald J, Bhatta R, Stewart R, McElligott AG (2022) Automated identification of chicken distress vocalisations using deep learning models. Journal of the Royal Society Interface 19, 20210921.

Take Home Messages

- Positive Animal Welfare is Vital for Livestock Health, Productivity

- Vocalisations can be used for monitoring Health and Welfare of Livestock, especially in large groups

"Our end goal is not to count distress calls, but to create conditions in which the chickens can live and have a reduced amount of stress..."

Funding - Thanks....

Buttercups Sanctuary for Goats

BBSRC, UK

Swiss National Science Foundation

Swiss Federal Veterinary Fund