EMOTIONAL RECOGNITION IN HORSES WITH CONVOLUTIONAL NEURAL NETWORKS

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OVERVIEW

- Horses and Behavior
- Horse communication and emotion
- Using neural networks to detect emotional expression in humans and animals
- Adaptation to horses through photos
- Results
- Limitations and implications for application and future research
Emotion is subjective mental state associated with the nervous system (Gendron, 2010).

Emotions in animals is based on this subjective state creating physiological and behavioral responses (Kremer et al., 2020).

Human emotions often gauged through facial expressions (Zuckerman et al., 1975) but subjective interpretations can be wrong (DePaulo, 1978; Creek & Watkins, 1972) suggesting a need for an objective approach.

Animals have emotions (Panksepp, 2005) and some even have facial expressions that convey emotions (Waller et al., 2013).
BACKGROUND

- Research supports the idea that emotions in animals can be measured through physiological and behavioral changes (Kremer et al., 2020; Paul et al., 2020). However, most of these studies have been done on companion animals as opposed to livestock or herbivores.

- Stress (via cortisol and correlating behaviors) has been measured in horses, cows, and other livestock as means of assessing psychological welfare (Leliveld et al., 2016; von Borell et al., 2007).

- High cortisol levels in horses has been linked to elevated head and neck position, widened eyes, ear positions, and increased muscle tension and movement (Budzynska, 2014; Yamell et al., 2013; Johnson et al., 2017).

- Existing ethograms of equine behavior in feral and semi-feral horse herds support the link between communication, expressions, and potential emotional affect (McDonnell & Aviland, 1995; Arnold & Grassia, 1982; McDonnell & Poulin, 2002).
BACKGROUND

- Physiological and Behavioral measures already used to study psychological and emotional welfare (Rietmann et al., 2004; Zelazna & Jerierski, 2018)
- Qualitative behavioral tools are also used to assess equine emotional state (Hintze et al., 2017; Hall et al., 2018)
- AnimalFaces identifies facial movements in nonhuman animals (Waller et al., 2013; Wathan et al., 2015; Vick et al., 2007)
- Current assessment tools support the development of a standardized technological means of determining emotional expression in horses
MATERIALS AND METHODS

- Existing studies on head, neck and ear position related to equine communication, intention, and presumed emotional state (McDonnell & Haviland, 1995; Arnold & Grassia, 1982; McDonnell & Poulin, 2002; Hall et al., 2018; Stewart et al., 2011; Peters et al., 2012).
# MATERIALS AND METHODS

<table>
<thead>
<tr>
<th></th>
<th>Alarmed</th>
<th>Curious</th>
<th>Relaxed</th>
<th>Annoyed</th>
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<tbody>
<tr>
<td></td>
<td>Eyes: open eyes with little or no sclera</td>
<td>Eyes: partially to mostly shut</td>
<td>Eyes: open with perhaps some sclera</td>
<td>Eyes: stiffly back or pinned back, close to the horse’s head</td>
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<tr>
<td></td>
<td>Ears: stiffly forward</td>
<td>Ears: relaxed, opening pointing to the sides</td>
<td>Ears: stiffly back or pinned back, close to the horse’s head</td>
<td>Nose: nostrils slightly closed, tense mouth or muzzle</td>
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<tr>
<td></td>
<td>Nose: open nostrils, usually slightly tense mouth or muzzle</td>
<td>Nose: relaxed mouth and muzzle</td>
<td>Nose: nostrils slightly closed, tense mouth or muzzle</td>
<td>Neck: approximately parallel or below</td>
</tr>
<tr>
<td></td>
<td>Neck: above parallel, head higher than back</td>
<td>Neck: usually parallel but may be slightly below or above</td>
<td>Neck: usually parallel or above parallel</td>
<td>Neck: usually parallel or above parallel</td>
</tr>
</tbody>
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MATERIALS AND METHODS
THE SYSTEM

- Detector
- Model
GETTING THE DATA

- No preexisting data set of horse faces
- Many pictures were not valid
- Some emotions had more pictures than others
THE DETECTOR

- Its responsibility is to detect the region of interest (the head and neck of the horse)

- Faster RCNN
MODEL

- Convolutional base (VGG16)
- Flatten layer
- Dense 256 nodes
- Dense 128 nodes
- Softmax 4 nodes

- Images rescaled to 150x150px
- Only some layers were trained
IMPLICATIONS, APPLICATION, AND FUTURE RESEARCH

- Supports the use and development of technology to detect and classify emotions in animals
- Could help veterinarians and behaviorists more accurately interpret horse behaviors
  - Improvements in accurate interpretations leads to better choices of responses/handling which can improve welfare.
- Help support future research in animal cognition and communication (intra and interspecies)
THANK YOU!