

Artificial neural networks for revealing important information in goat contact calls

A.G. Mcelligott¹, E.F. Briefer² and L. Favaro³

¹Queen Mary, University of London, Biological and Experimental Psychology, School of Biological and Chemical Sciences, Mile End Rd, London, E1 4NS, United Kingdom, ²ETH Zürich, Institute of Agricultural Sciences, Universitätstrasse 2, 8092 Zürich, Switzerland, ³University of Torino, Department of Life Sciences and Systems Biology, Via Accademia Albertina 13, 10123 Turin, Italy; a.g.mcelligott@qmul.ac.uk

Machine learning techniques are becoming an important tool for studying animal vocal communication. The goat (*Capra hircus*) is a very social species, in which vocal communication and recognition are important. We tested the reliability of a Multi-Layer Perceptron (feed-forward ANN) to automate the process of classification of goat kid calls according to individual identity, group membership and maturation in this species. Vocalisations were obtained from 10 half-sibling (same father but different mothers) kids, belonging to 3 distinct social groups. We recorded 157 contact calls emitted during first week, and 164 additional calls recorded from the same individuals at 5 weeks. For each call, we measured 27 spectral and temporal acoustic parameters using a custom built program in the Praat software. For each classification task we built stratified 10-fold cross-validated neural networks. The input nodes corresponded to the acoustic parameters measured on each signal. ANNs were trained with the error-back-propagation algorithm. The number of hidden units was set to the number of attributes + classes. Each model was trained for 300 epochs (learning rate 0.2; momentum 0.2). To estimate a reliable error of the models, we repeated 10-fold cross-validation iterations 10 times and calculated the average predictive performance. The accuracy was $71.13 \pm 1.16\%$ for vocal individuality, $79.59 \pm 0.75\%$ for social group and $91.37 \pm 0.76\%$ for age of the vocalising animal. Our results demonstrate that ANNs are a powerful tool for studying vocal cues to individuality, group membership and maturation in contact calls. The performances we achieved were higher than those reported for similar classification tasks using classical statistical methods such as Discriminant Function Analysis. Further studies, investigating the reliability of these algorithms for the real-time classification of contact calls and comparing ANNs with other machine learning techniques are important to develop technology to remotely monitor the vocalisations of domestic livestock.