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Deciphering Orangutan Drawing Behavior Using Artificial Intelligence

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Abstract : To this day, it is not known if drawing is specifically human behavior or if this behavior finds its origins in ancestor species. An interesting window to enlighten this question is to analyze the drawing behavior in genetically close to human species, such as non-human primate species. A good candidate for this approach is the orangutan, who shares 97% of our genes and exhibits multiple human-like behaviors. Focusing on figurative aspects may not be suitable for orangutans' drawings, which may appear as scribbles but may have meaning. A manual feature selection would lead to an anthropocentric bias, as the features selected by humans may not match with those relevant for orangutans. In the present study, we used deep learning to analyze the drawings of a female orangutan named Molly († in 2011), who has produced 1,299 drawings in her last five years as part of a behavioral enrichment program at the Tama Zoo in Japan. We investigate multiple ways to decipher Molly's drawings. First, we demonstrate the existence of differences between seasons by training a deep learning model to classify Molly's drawings according to the seasons. Then, to understand and interpret these seasonal differences, we analyze how the information spreads within the network, from shallow to deep layers, where early layers encode simple local features and deep layers encode more complex and global information. More precisely, we investigate the impact of feature complexity on classification accuracy through features extraction fed to a Support Vector Machine. Last, we leverage style transfer to dissociate features associated with drawing style from those describing the representational content and analyze the relative importance of these two types of features in explaining seasonal variation. Content features were relevant for the classification, showing the presence of meaning in these non-figurative drawings and the ability of deep learning to decipher these differences. The style of the drawings was also relevant, as style features encoded enough information to have a classification better than random. The accuracy of style features was higher for deeper layers, demonstrating and highlighting the variation of style between seasons in Molly's drawings. Through this study, we demonstrate how deep learning can help at finding meanings in non-figurative drawings and interpret these differences.

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