An Application of Computer Vision in Automating Behavioral Analysis of Predator Odor Exposure in Rats

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The accurate identification and analysis of stress-reactive behaviors in laboratory rats during predator odor exposure is critical for understanding the underlying mechanisms of stress and trauma responses. This study implemented a novel approach to automate this process, using DeepLabCut to develop a deep learning model that can locate anatomical features and perform accurate pose estimation of the rats, and SimBA to build machine learning classifiers that can identify and generate descriptive statistics for two stress-reactive behaviors, immobility and digging. Our results demonstrated that SimBA generated predictions that were highly correlated with manual annotations obtained using ANY-Maze. However, SimBA predicted significantly more time for immobility and significantly less time for digging compared to manual annotations, suggesting the need to adjust the sensitivity and precision of the classifiers. Tuning the discrimination thresholds of the models resulted in slightly improved prediction accuracy. It was found that applying SimBA's Kleinberg smoothing feature in predicting behavioral bouts along with tuning the discrimination thresholds was necessary in optimizing the predictive accuracy for digging behavior. These findings highlight the potential of using DeepLabCut's pose estimation deep learning algorithms in conjunction with SimBA's machine learning classifiers to automate the analysis of stress-reactive behaviors in laboratory rats, providing a more efficient and objective method of quantifying behaviors.