



Simple Behavioral Analysis (SimBA) as a platform for explainable machine learning in behavioral neuroscience

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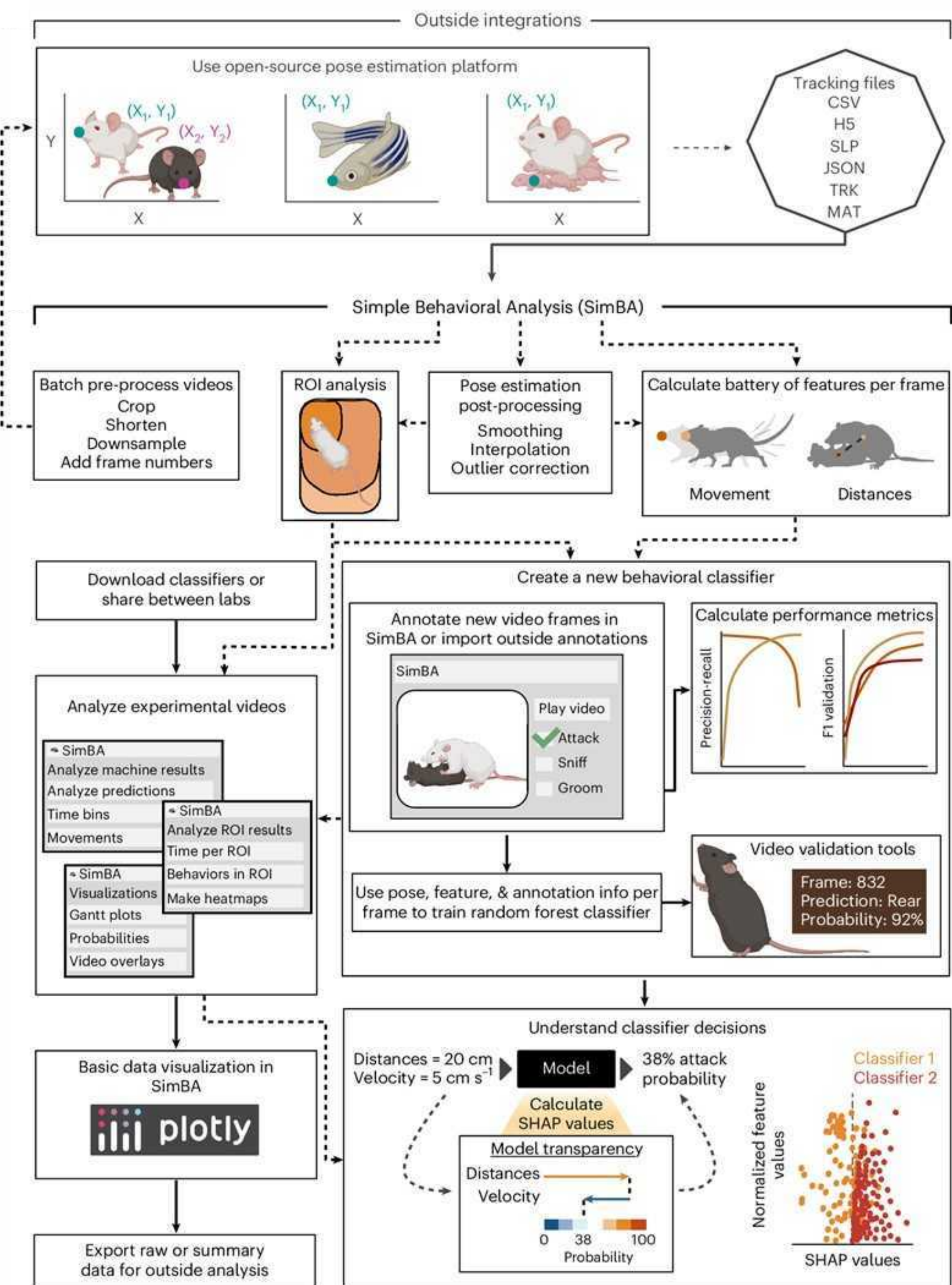


Background

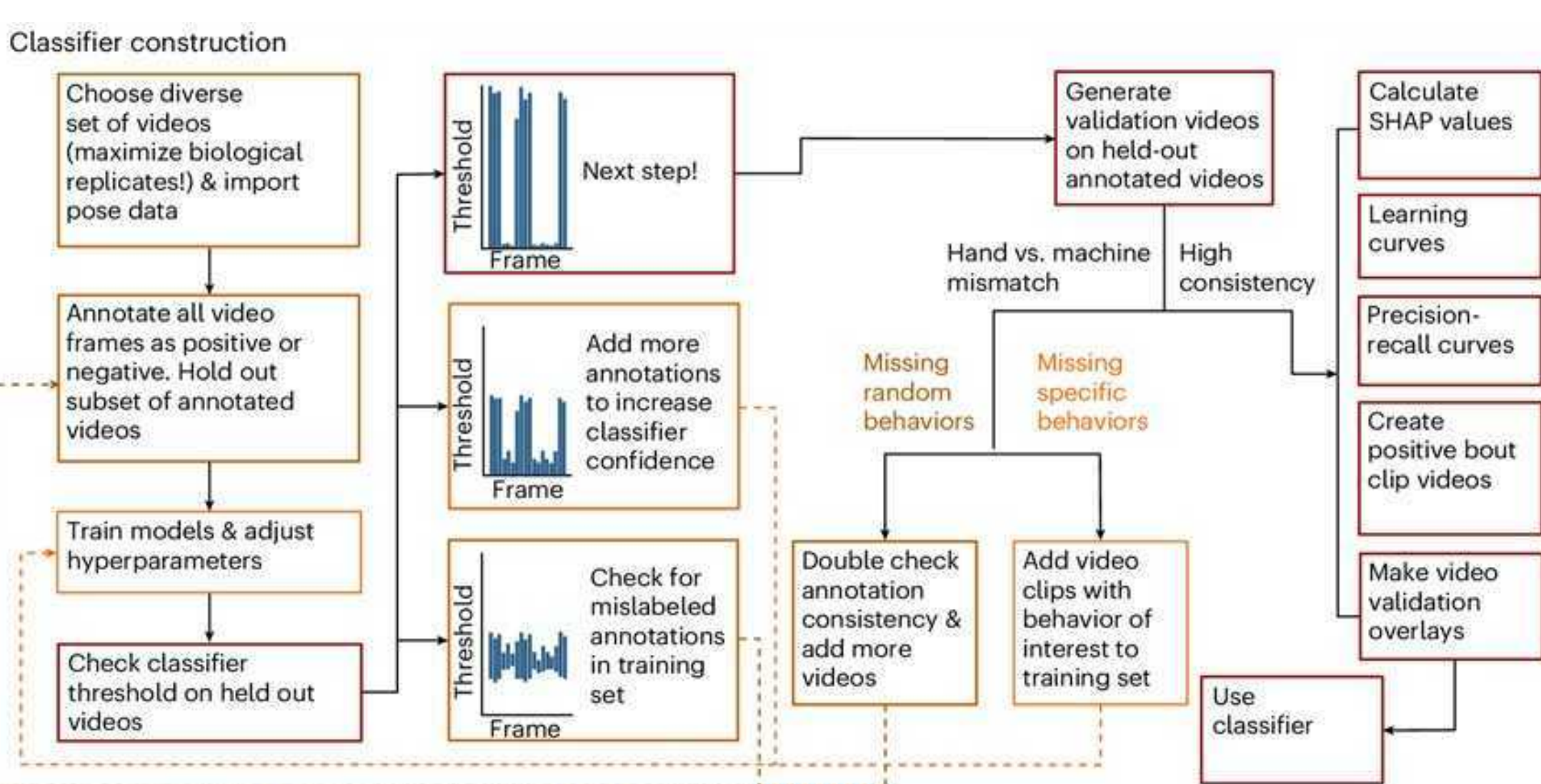
The study of complex behaviors is often challenging when using manual annotation due to the absence of quantifiable behavioral definitions and the subjective nature of behavioral annotation. Integration of supervised machine learning approaches mitigates some of these issues through the inclusion of accessible and explainable model interpretation. To decrease barriers to access, and with an emphasis on accessible model explainability, we developed the open-source Simple Behavioral Analysis (SimBA) platform for behavioral neuroscientists. SimBA introduces several machine learning interpretability tools, including SHapley Additive exPlanation (SHAP) scores, that aid in creating explainable and transparent behavioral classifiers. Here we show how the addition of explainability metrics allows for quantifiable comparisons of behavior, reconceptualizing behavior as a sharable reagent and providing an open-source framework. We provide an open-source, graphical user interface (GUI)-driven, well-documented package to facilitate the movement toward improved automation and sharing of behavioral classification tools across laboratories.

Simple Behavioral Analysis (SimBA)

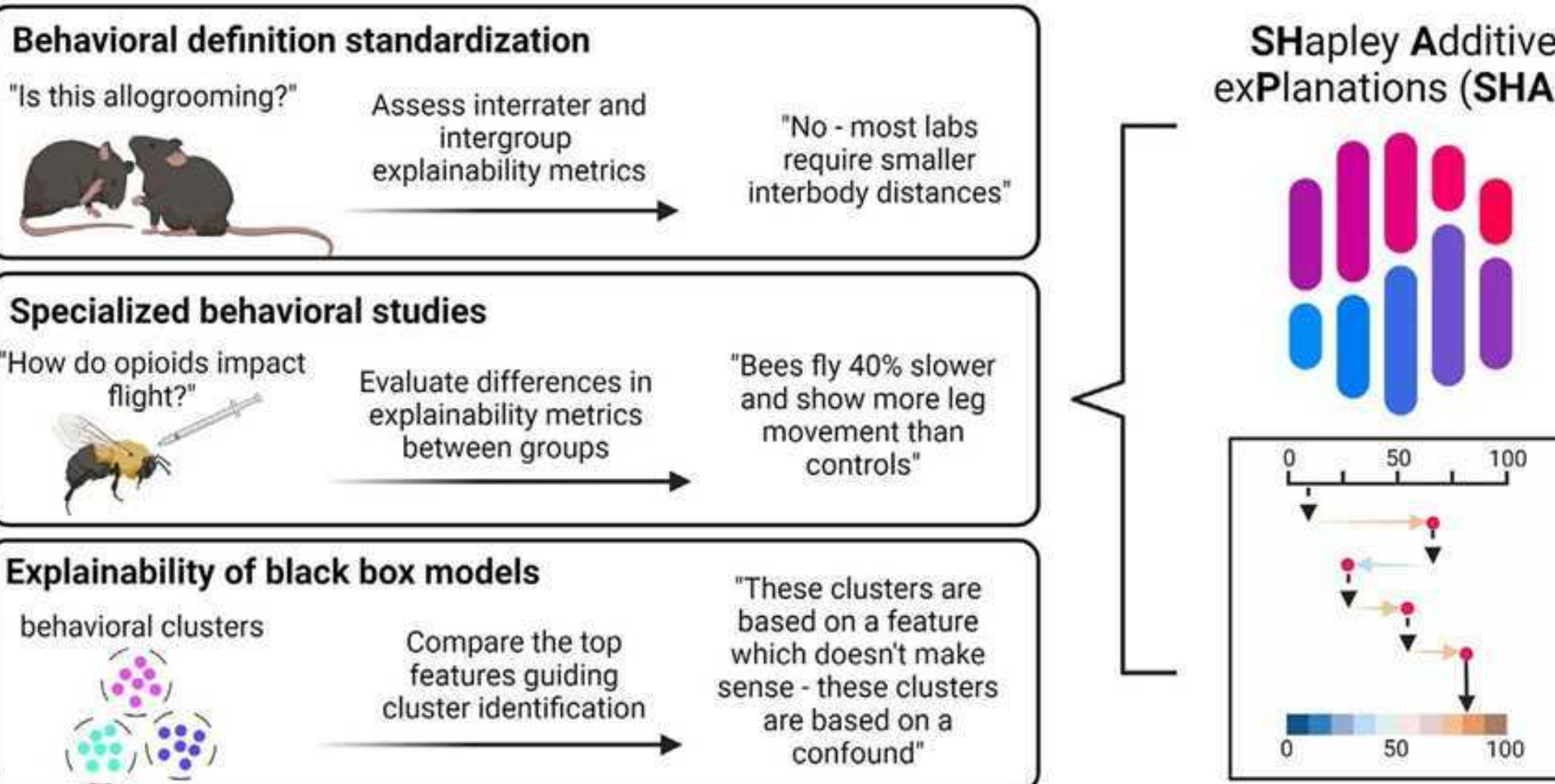
SimBA is modular, open-source, GUI-based program designed to address the specific analysis needs of behavioral neuroscientists.



Workflow for high-fidelity and generalizable supervised behavioral classifiers. Users are guided through each step, and results validated.

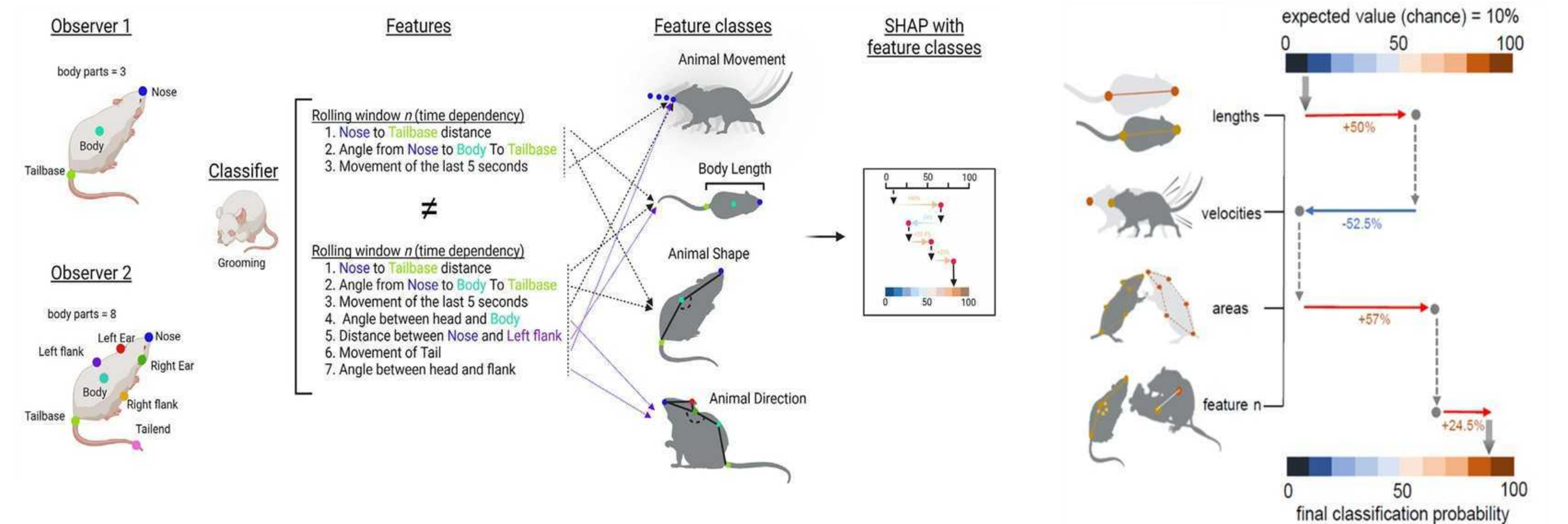


Enhancing the rigor of behavioral analysis through explainability metrics



Goodwin *et al.*, 2024, Nature Neuroscience, PMID: 38778146
Goodwin *et al.*, 2022, Current Opinion in Neurobiology, PMID: 35487088
Goodwin *et al.*, 2020, Psychopharmacology, PMID: 32647898

Feature binning and SHAP as a platform for explainable machine learning in behavioral neuroscience

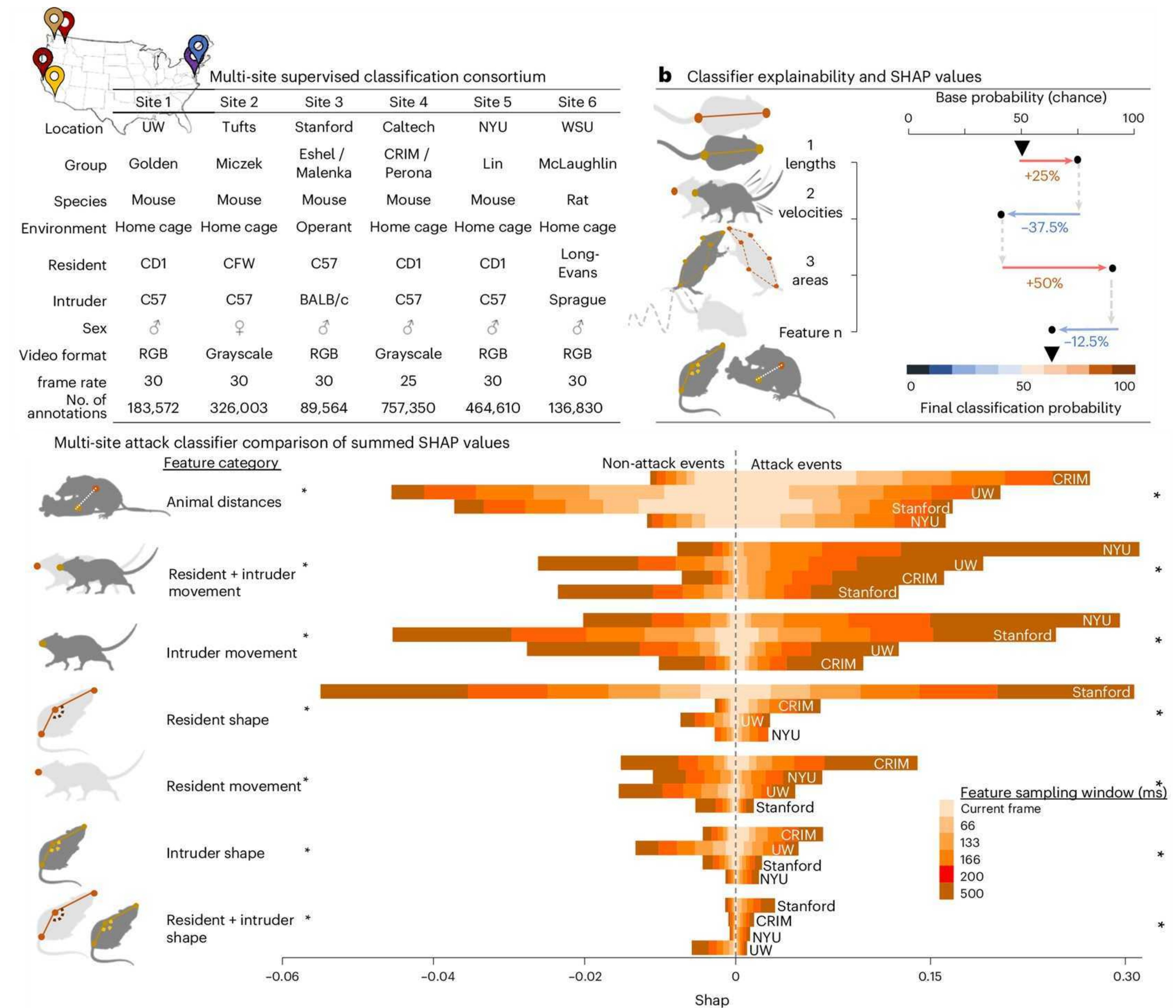


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Behavior as a shareable reagent

The incorporation of machine-learning-based behavioral analysis coupled with explainability metrics produce comprehensive quantitative operational definitions of behavior. This allows us to re-conceptualize behavioral analysis through precise and verbalizable statistical component rules that are applied when scoring behaviors of interest. These quantified definitions can be shared as resources, akin to RRID-like reagents, enhancing transparency and reportability and reproducibility.



Social stress experience influences aggression and coping behaviors differently in males and females.

We used SimBA to analyze male and female social stress behavior. Between sexes, we found that male and females differ significantly in their coping strategies, with females defending themselves less than males. These differences may partially explain differences in resilience to social stress between males and females.

