# EXPANDING THE HORIZONS OF REHABILITATIVE NEUROSCIENCE THROUGH DEEP NEURAL NETWORKS

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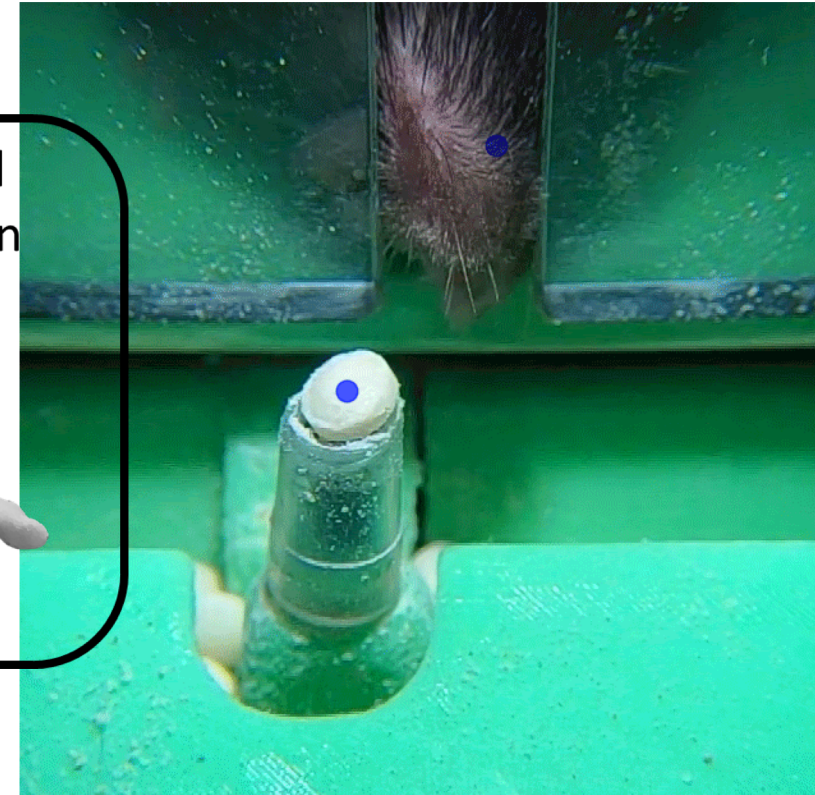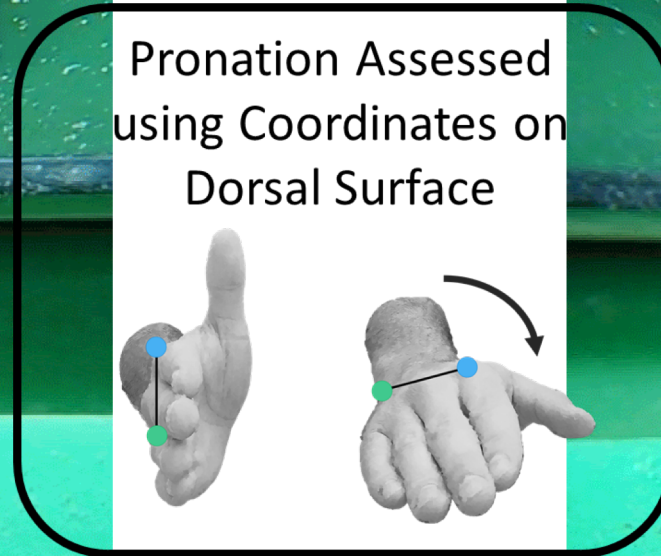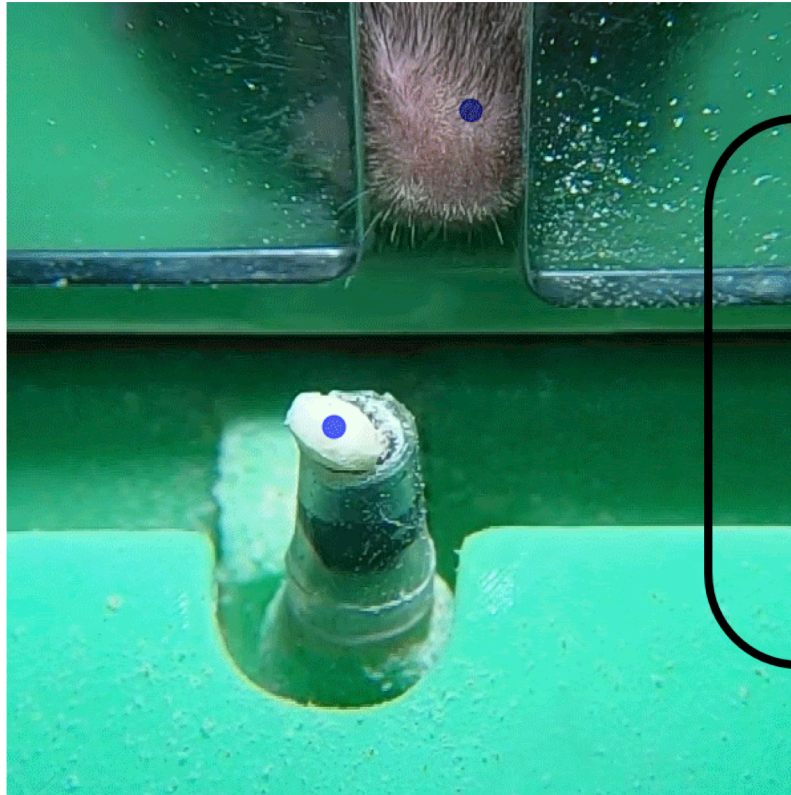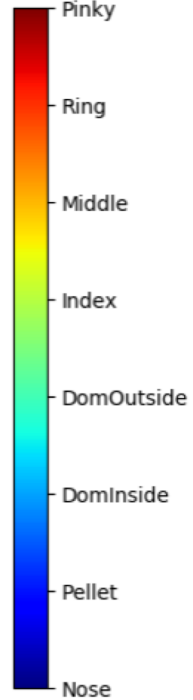
DeepLabCut
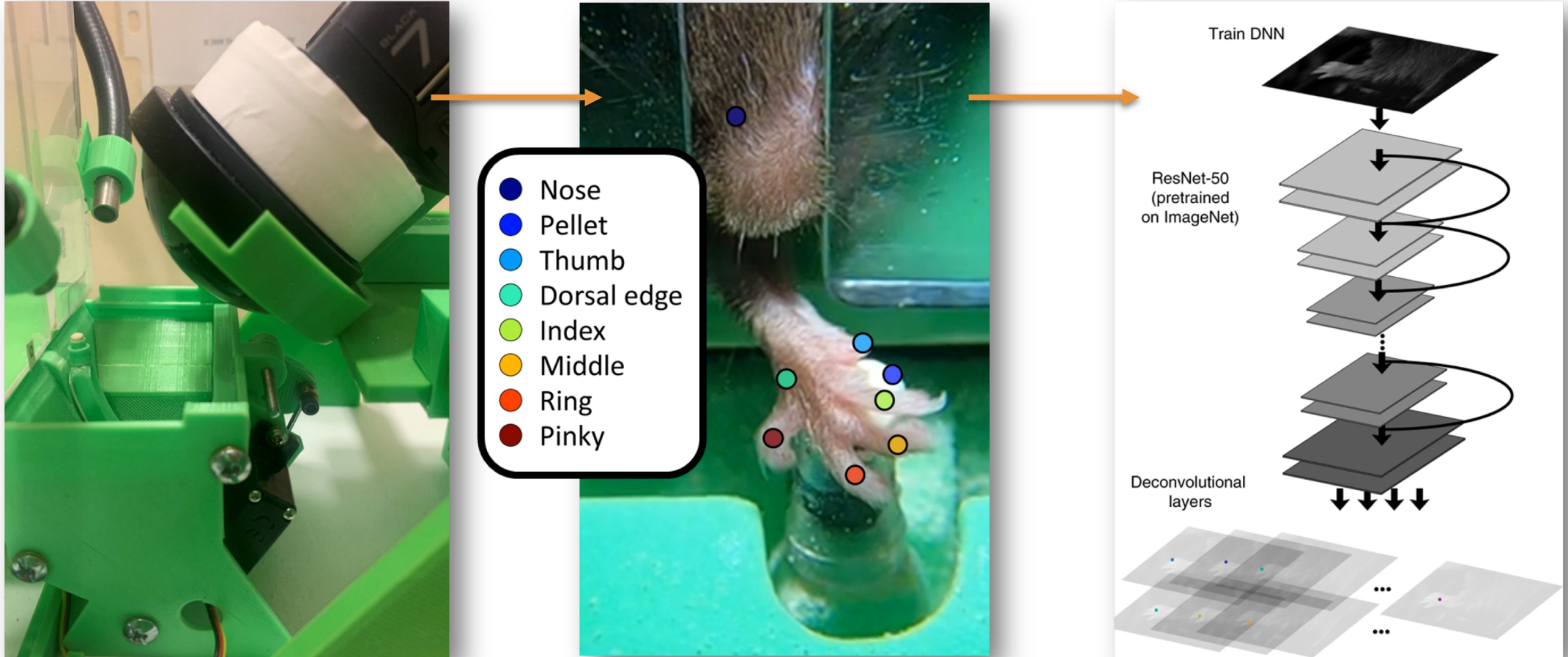
DNNs allow us to automate behavioral analysis of normal and injured mice
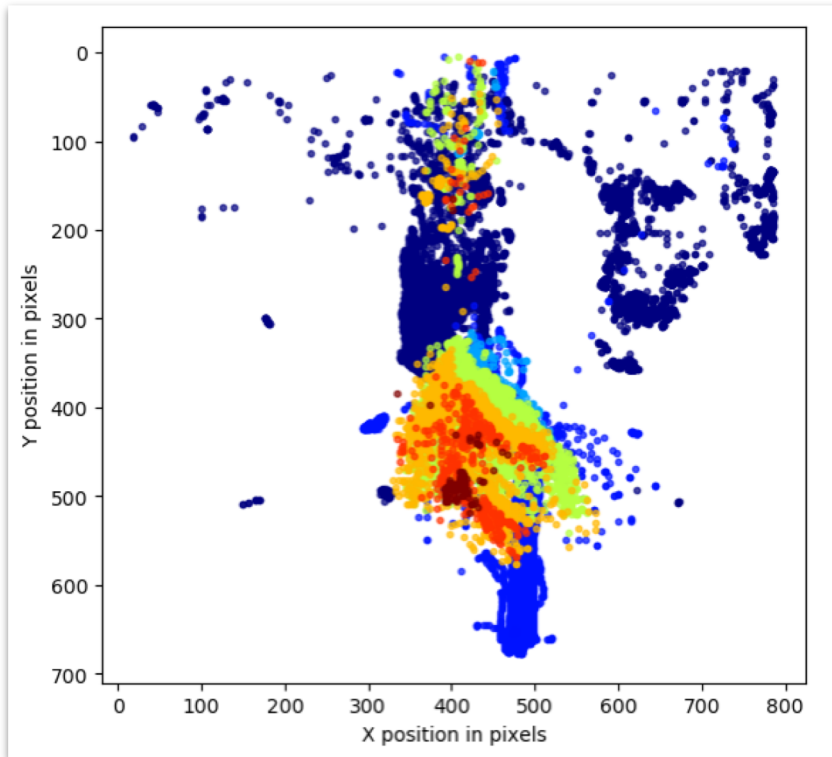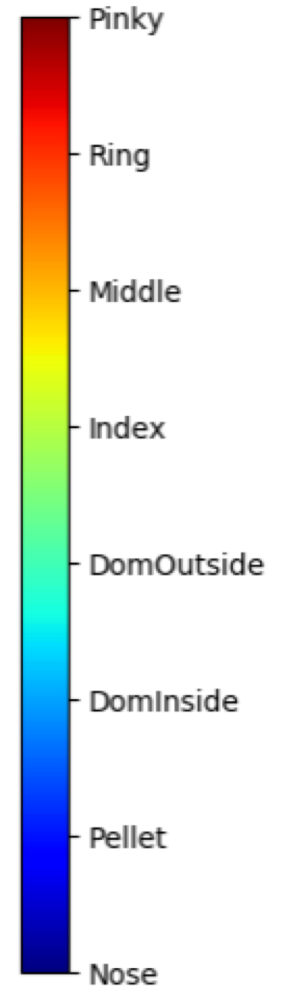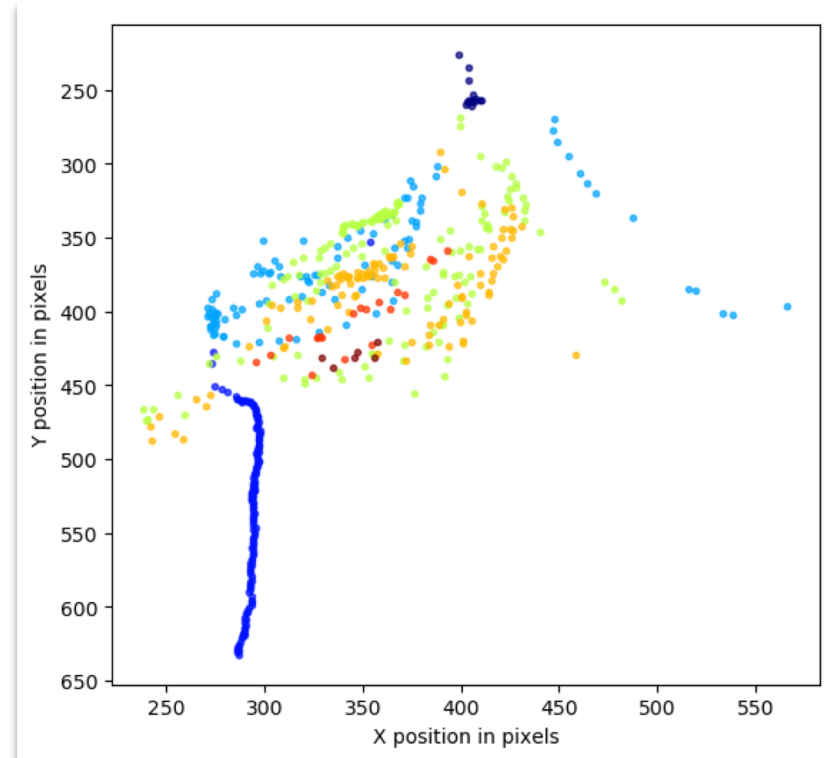
Visual Study of a Mouse's Recovery Post Spinal Cord Injury (PSCI)
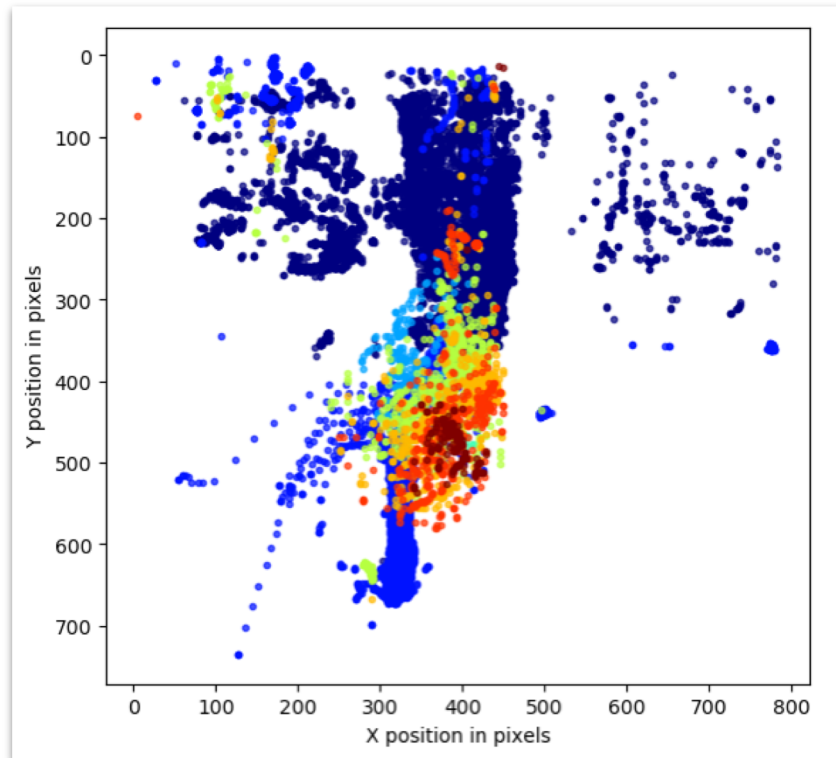
6-minutes plot of body parts
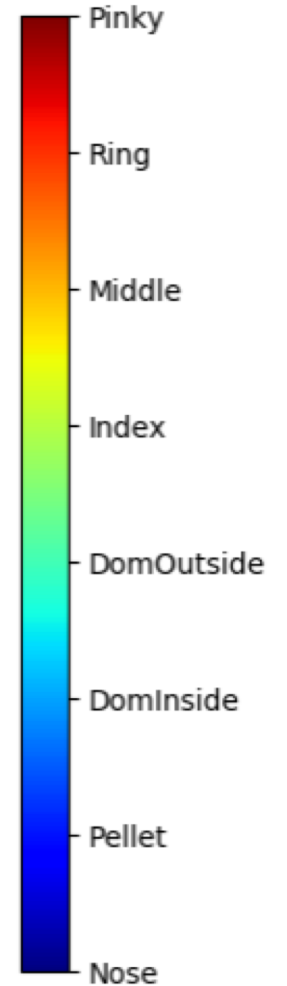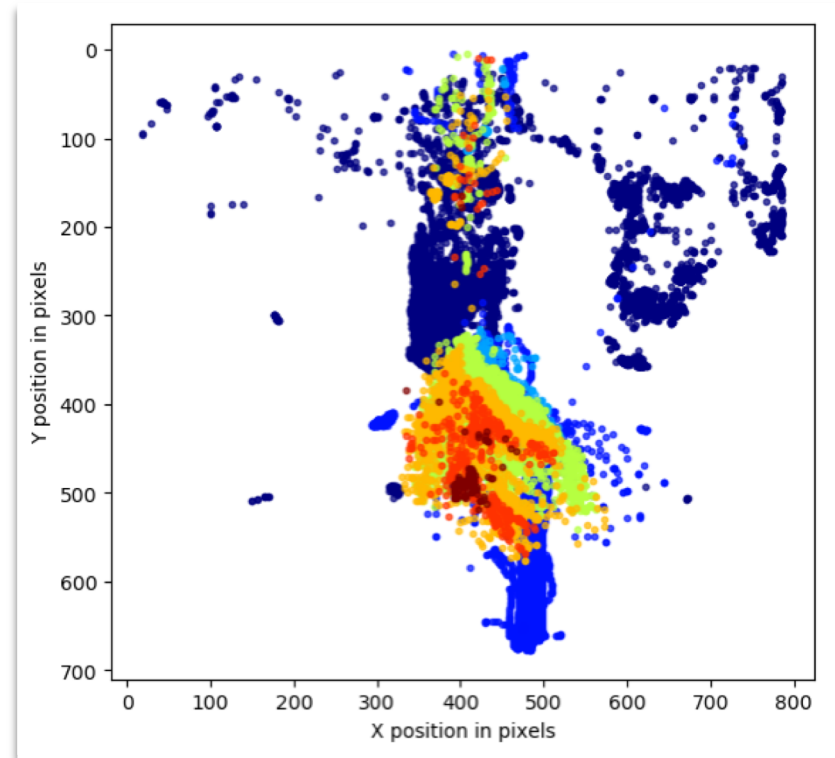
Single success - 1 second

Visual Study of a Mouse's Recovery Post Spinal Cord Injury (PSCI)
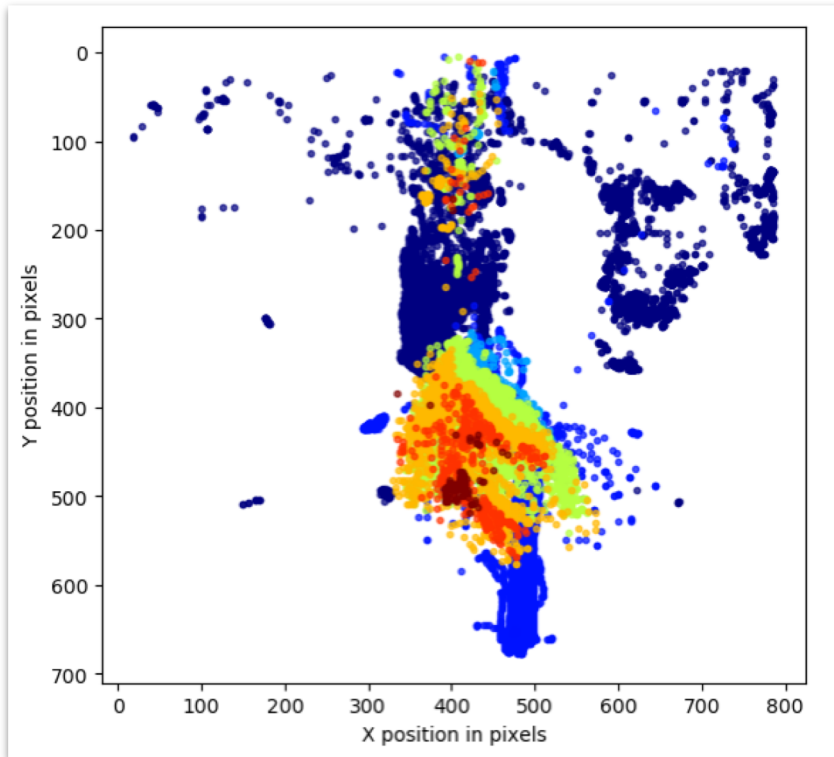

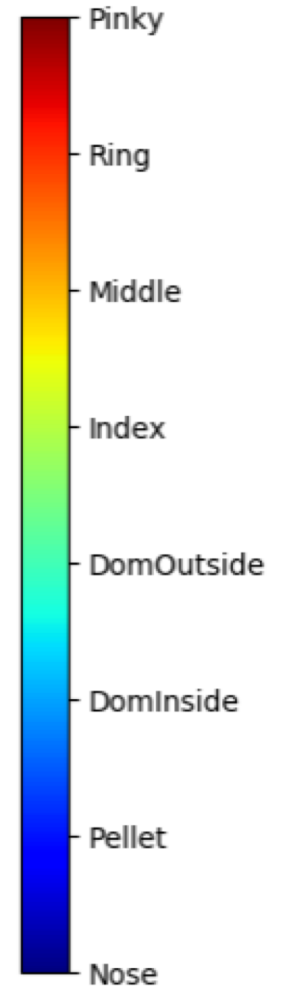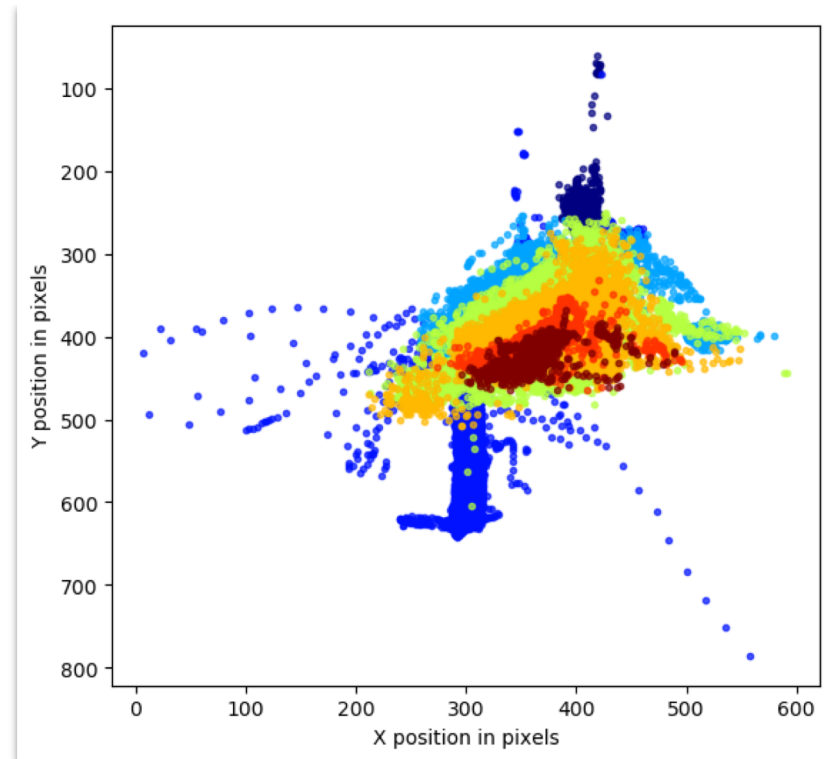1st day of training – PRE-Injury

Last day of training

Visual Study of a Mouse's Recovery Post Spinal Cord Injury (PSCI)


Last day of training - PRE-injury

3-week PSCI

Performance of DNN is optimized through multiple parameters

Depth	Training Error
Resnet50	*~4.60*
Resnet101	*~4.00*
Resnet152	*~4.00*

Learning Rate	Training Error	Iterations
SGD	4.62	*~300k*
Adam	4.13	*~100k*
CLR	3.83	*~75k*

Image Augmentation	Training Error
Default (*adam, Resnet101*)	4.62
Image Augmentation	3.90
Image Augmentation +Tensorpack	3.83

Training Error vs. Depth

Number of Iterations to reach same loss
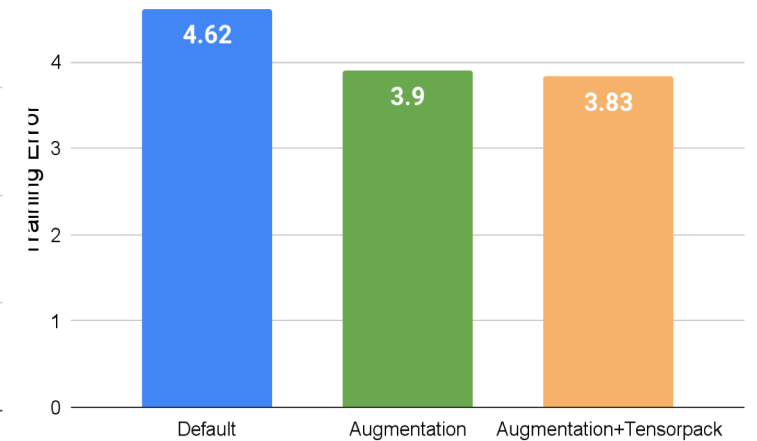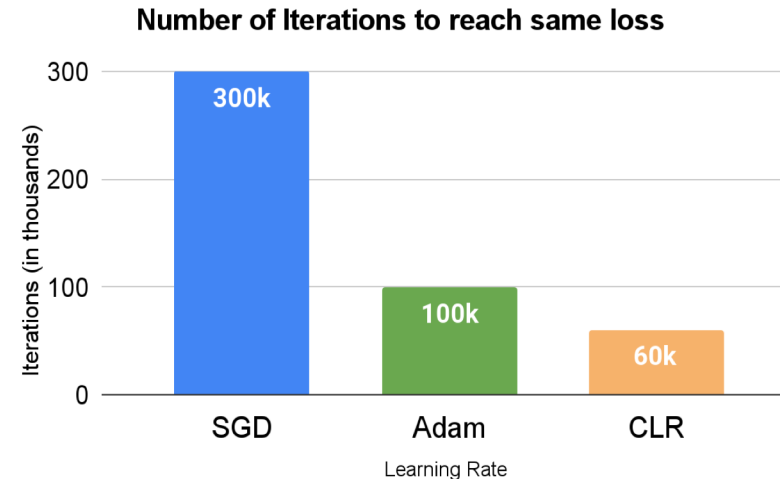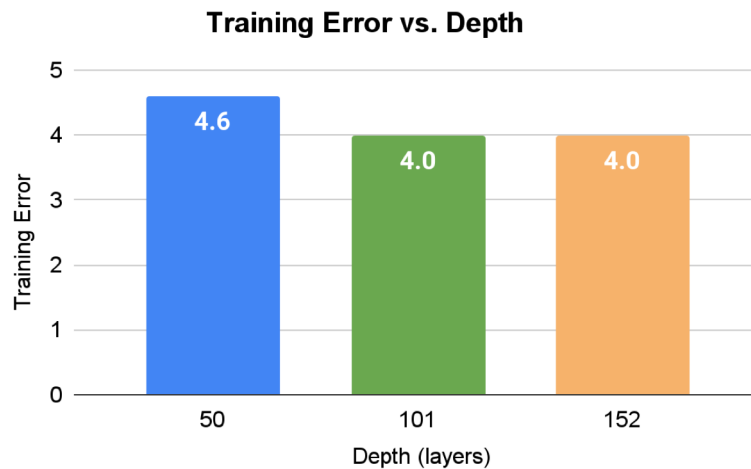
Miniscule distortions can destroy even the most robust neural network
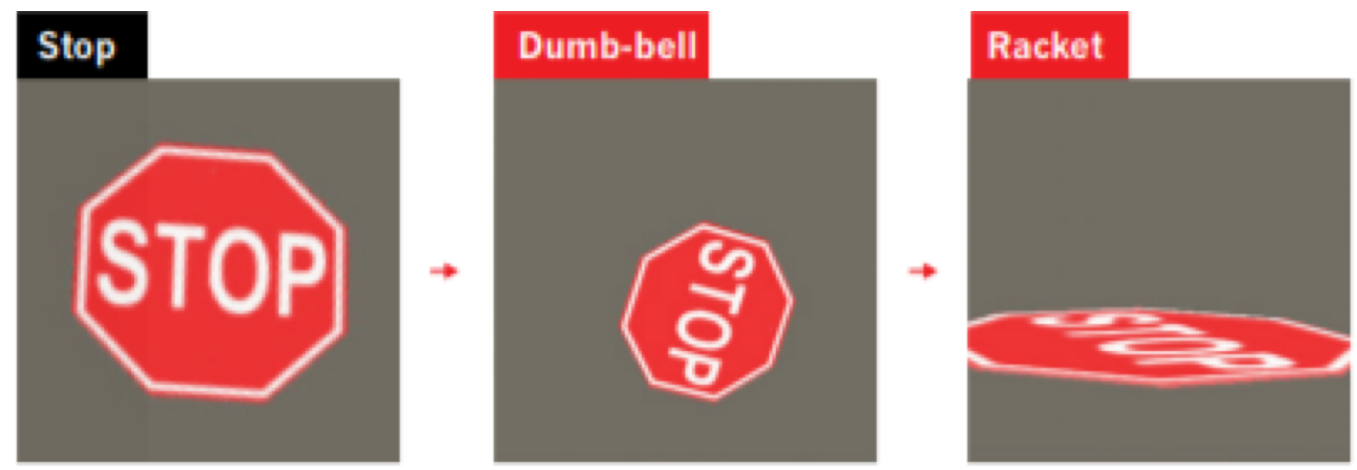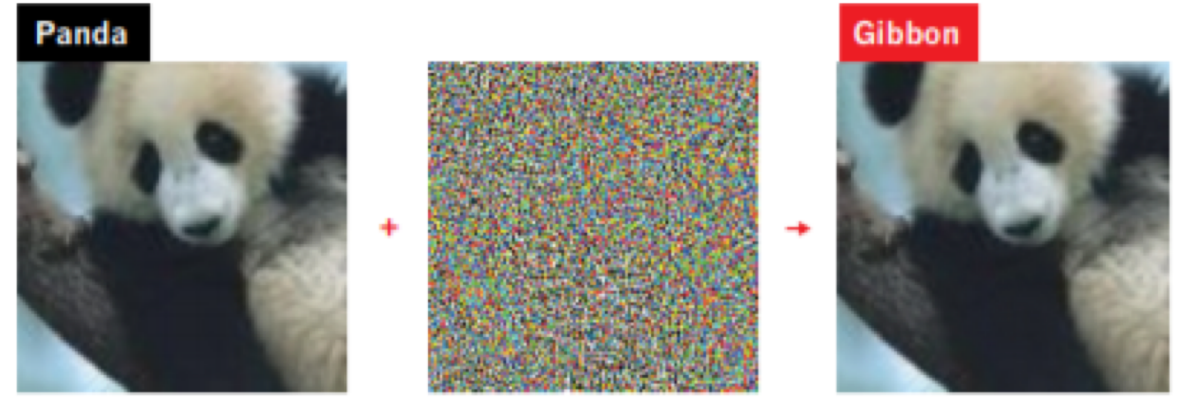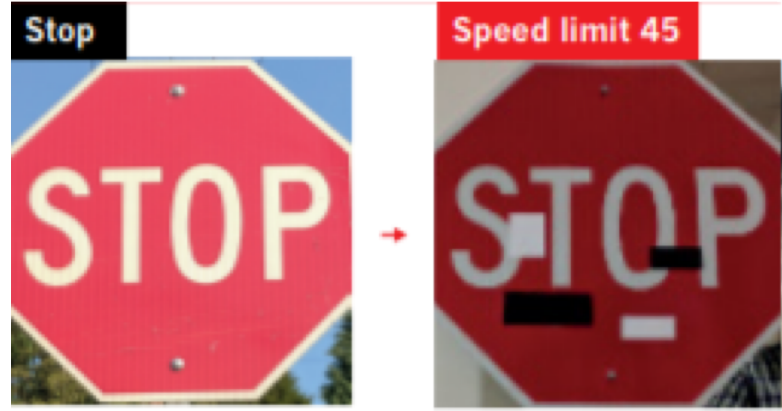
Training Error of DNN determines quality but not quantity of label outcomes

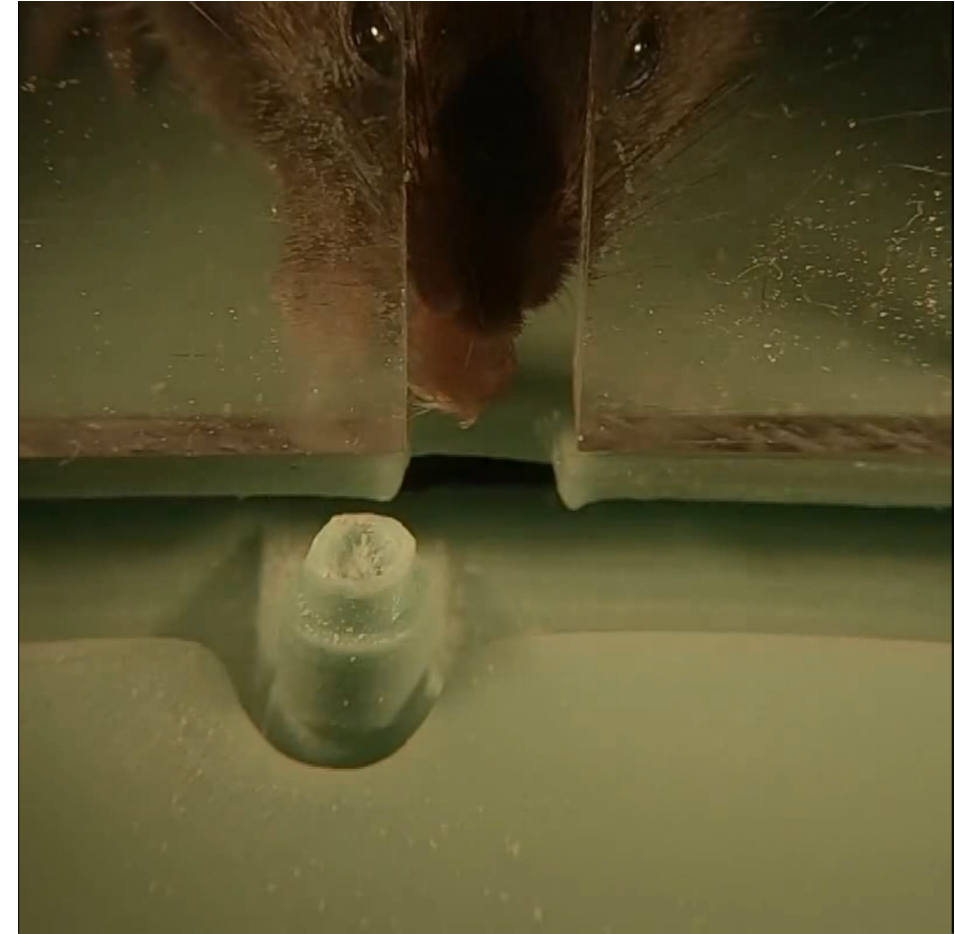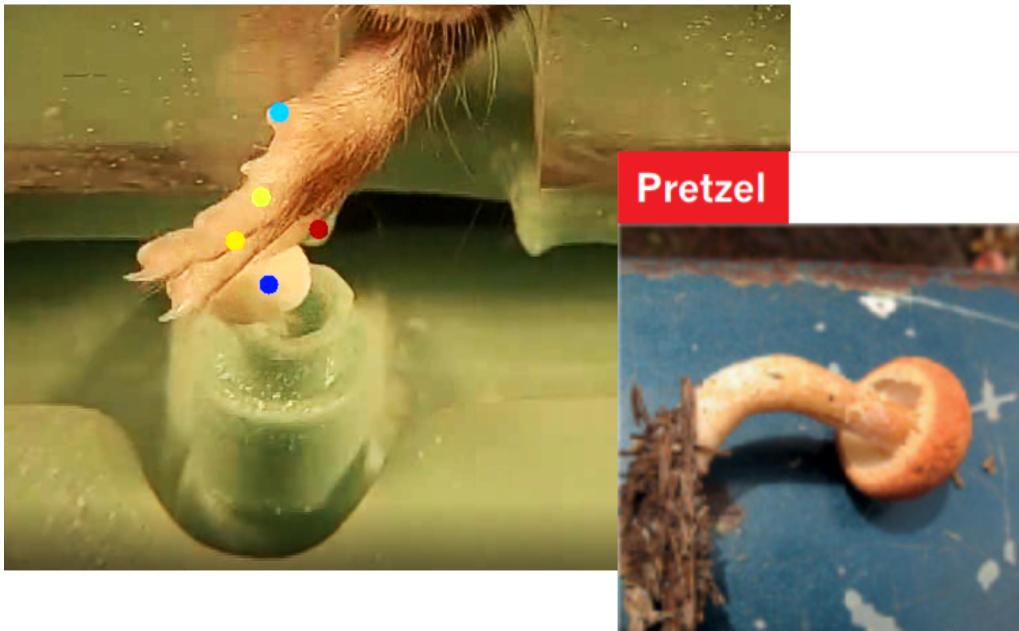| DNN	Resnet**101**, Adam	Resnet**152**, Adam+CLR, Tensorpack, Image Augmentation
Training Error	3.80	3.80

Future Directions: How to further prime the DNN to become foolproof

1. Augmenting image dataset through matrix transformations (rotations, shears, etc)
2. Extracting outlier frames

Team Science Is The Way To Go

LemBix Lab (2021 version)

Vance Lemmon
John Bixby

Nick O'Neill (computation, AI, behavior)
Kar Men Mar (in vivo, behavior)

Hassan Al-Ali (thinking, math, screening)
Yania Martinez (screening, AAVs)
Yan Shi (high content analysis)
Matt Danzi (computation, AI, genomics)
Melissa Munoz (everything wet, behavior)

Zheng
Wang
Tong Liu