The performance of the various cross-validation method parameters was assessed for both adult monkey neurons and young monkey neurons. The parameters tested were number of K-Folds, Holdout percentage, and the Leave-One-Out method of MATLAB’s built-in cross validation function (crossval.m).

The initial testing for adult monkey neurons included 1694 neurons across 4 monkeys, which was narrowed to 1299 neurons after removal of any neuron that did not have exactly 8 trial entries for all 8 classes. The young monkey neuron group included 855 neurons across 4 monkeys, which was narrowed to 690 neurons used for the cue rates. These final neuron groups (1299 for adult, 690 for young) were used to initially train the decoder using the fitcecoc.m function.

K-fold testing was completed using k-folds of 2 to 20, and an average loss was computed across 10 trials at each k-fold. Holdout testing was completed using holdout percentages of 2% to 100%, at increments of 2%, with an average loss computed across 10 trials for each percentage. Leave-one-out testing was completed as the average loss was computed across 10 trials of the leave-one-out method. All the parameters of interest were saved in adult\_crossvalparams.mat or young\_crossvalparams.mat matfiles, for the two groups of neurons.

**Parameter comparison between young and adult using all available neurons**

**Chart, line chart

Description automatically generated**

**Chart, line chart

Description automatically generatedGraphical user interface

Description automatically generated with medium confidence**

The same method was repeated, however this time maintaining a constant number of neurons used for each group (adult and young) by performing a random permutation of the neurons to choose 200 neurons from each group at random to train the decoder. All parameters for both adult and young neuron groups were saved in matfiles labeled “aperm\_crossvalparams.mat” and “yperm\_crossvalparams.mat”.

**Parameter comparison between young and adult for 200 randomly selected neurons**

**Chart, line chart

Description automatically generated**

**Chart, line chart, histogram

Description automatically generated**

**Graphical user interface

Description automatically generated with low confidence**

Finally, the decoder performance was also plotted for each group (adult and young) to show performance differences when all available neurons were used versus 200 randomly selected neurons.

**Adult group performance differences**

**Chart, line chart

Description automatically generated**

**Chart, line chart

Description automatically generated**

Chart

Description automatically generated

**Young group performance differences**

**Chart, line chart

Description automatically generated**

**Chart

Description automatically generated**

Chart

Description automatically generated with medium confidence

**Performance Results**

The decoder performed consistently better with the adult neurons than it did with the young neurons, which was less stated when measuring the holdout parameter. The decoder also performed much better for both young and adult groups when more neurons were used in crossvalidation training of the decoder, as expected.

For the adult group, the original ideal parameters values were K-Fold = 9 and holdout percentage = 24%. These parameters changed to K-Fold = 10 and holdout percentage = 2% when only 200 neurons were considered. However, besides the unexpected holdout percentage max at 2%, the second local holdout maximum was at 16%.

For the young group, the original ideal parameters values were K-Fold = 8 and holdout percentage = 8%. These parameters changed to K-Fold = 4 and holdout percentage = 20% when only 200 neurons were considered.