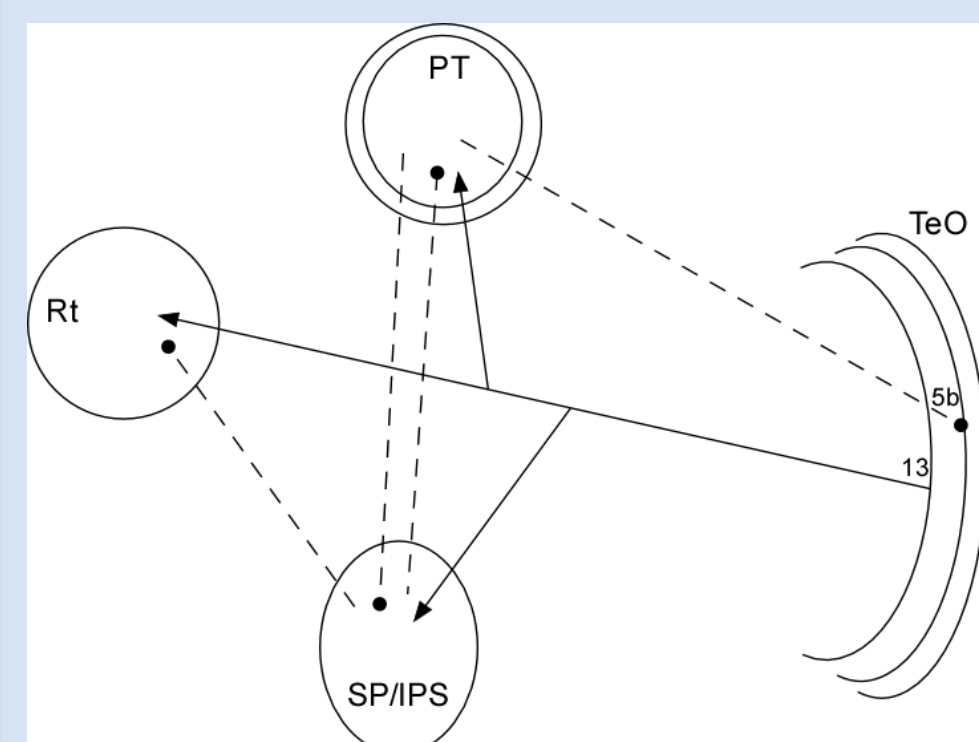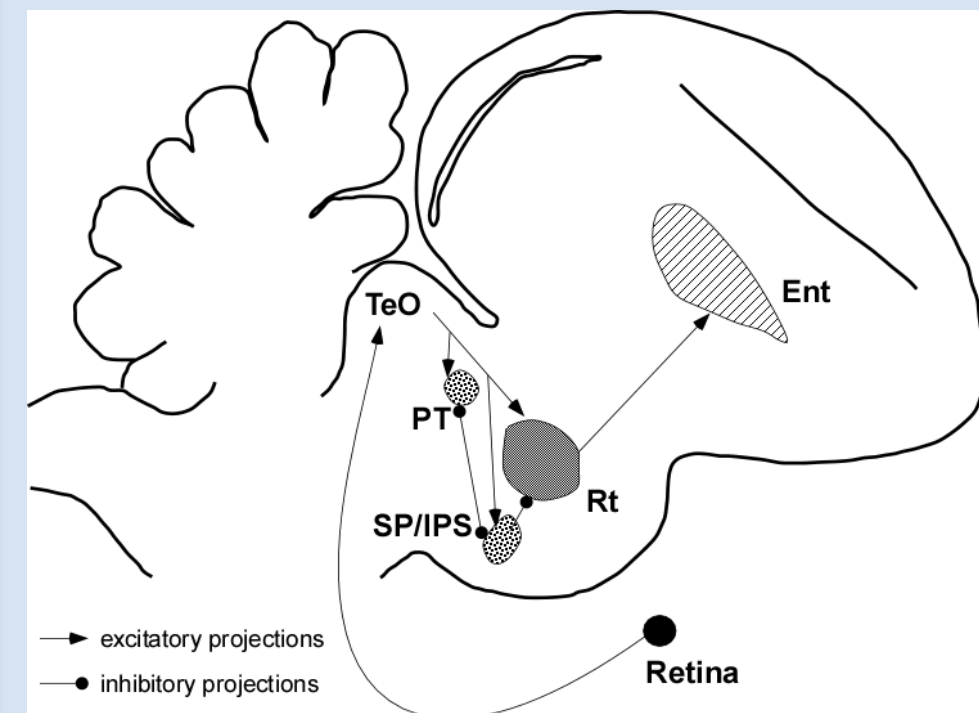# Impairment of Figure-Ground and Shape Discrimination After Lesion of Nucleus Subpretectalis in Pigeons

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Background

❖ Collothalamic visual pathway is a major source of visual information (90%; Shimizu & Watanabe, 2012)
  o Retina → Optic tectum → Nucleus rotundus → Entopallium
❖ N. rotundus (Rt) is the largest midbrain nucleus in birds
  o Change from retinotopic organization to functional organization
  o Several functional subdivisions
❖ Receives inhibitory input from nucleus subpretectalis/interstitio-pretecto-subpretectalis (SP/IPS)
❖ Earlier study (Acerbo et al., submitted) demonstrated higher activity of Rt and SP/IPS only after figure-ground discrimination
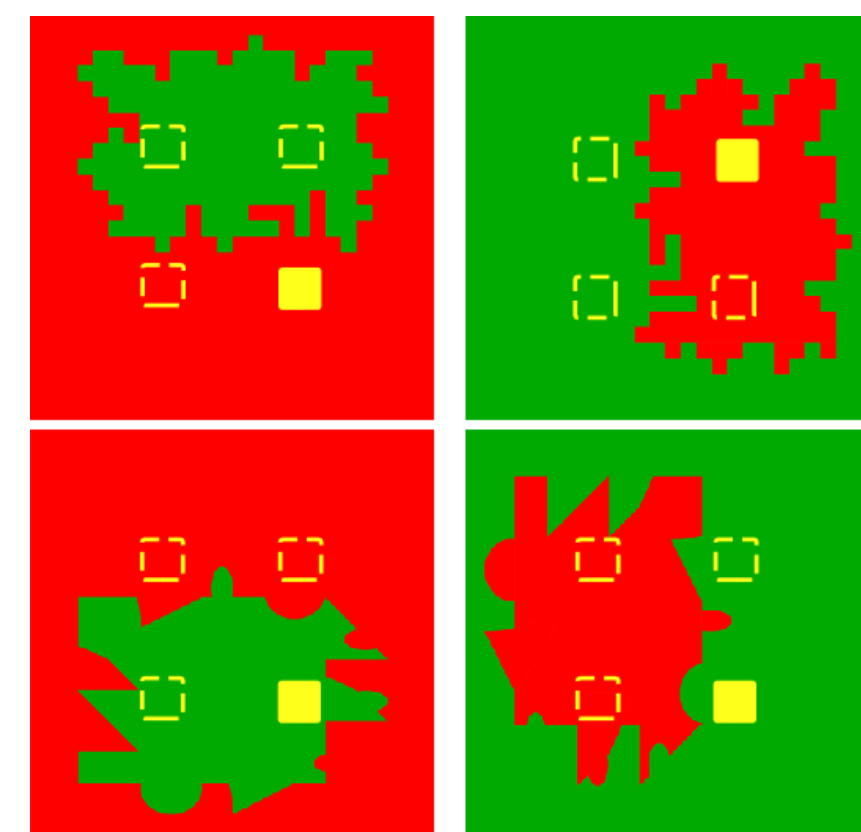
Hypothesis

Effect of lesion of SP/IPS will depend on the type of visual discrimination
1) Color discrimination – no effect
2) Figure-ground discrimination – impairment
3) Shape discrimination – no effect

Method

(modified from Lazareva et al., 2006)

Stimuli
❖ Target presented in one of four locations, equally often on figure or ground region (see left)

Subjects
❖ 10 homing pigeons, kept at 85% of free-feeding weight (8 lesioned so far)

Procedure
❖ Three trial types: shape, color, and figure-ground presented in blocks of 40 trials (total 120 trials)
❖ Additional shape training (128 trials) as needed after first 10 days of training
❖ Once criterion is reached, lesion n. subpretectalis

Surgery
❖ Anesthetize with Nembutal
❖ Experimental group: Bilateral ibotenic acid injection to lesion SP/IPS
❖ Sham group: Injection of artificial cerebrospinal fluid

Recovery
❖ Five-day recovery
❖ Retraining until 5 completed training sessions are collected
❖ Sacrifice bird with overdose of Nembutal
❖ Extract brain and analyze region of interest for volume and location of lesion (in process)

correction trial
food
intertrial interval
until choice key is selected
peck
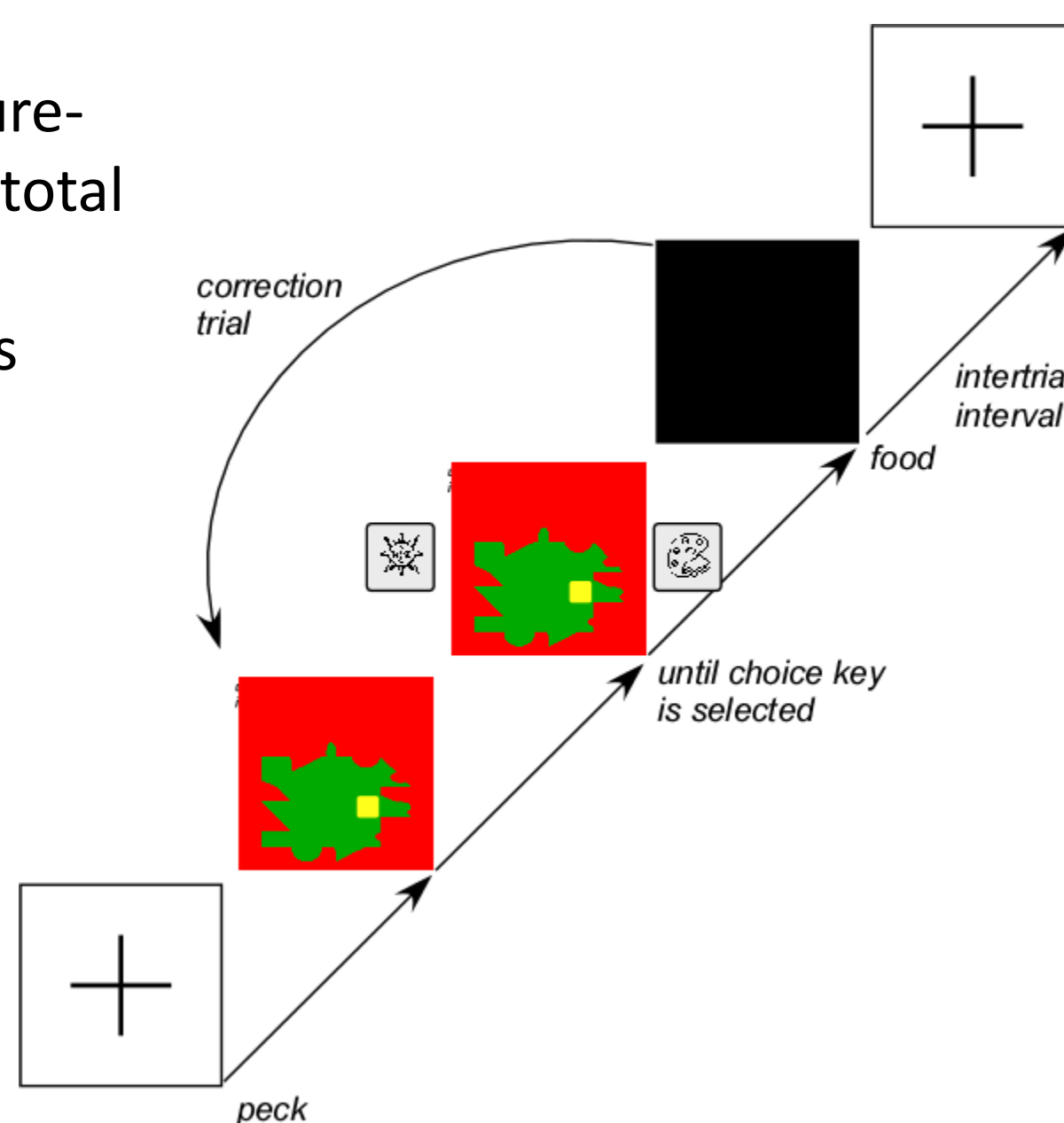
Results
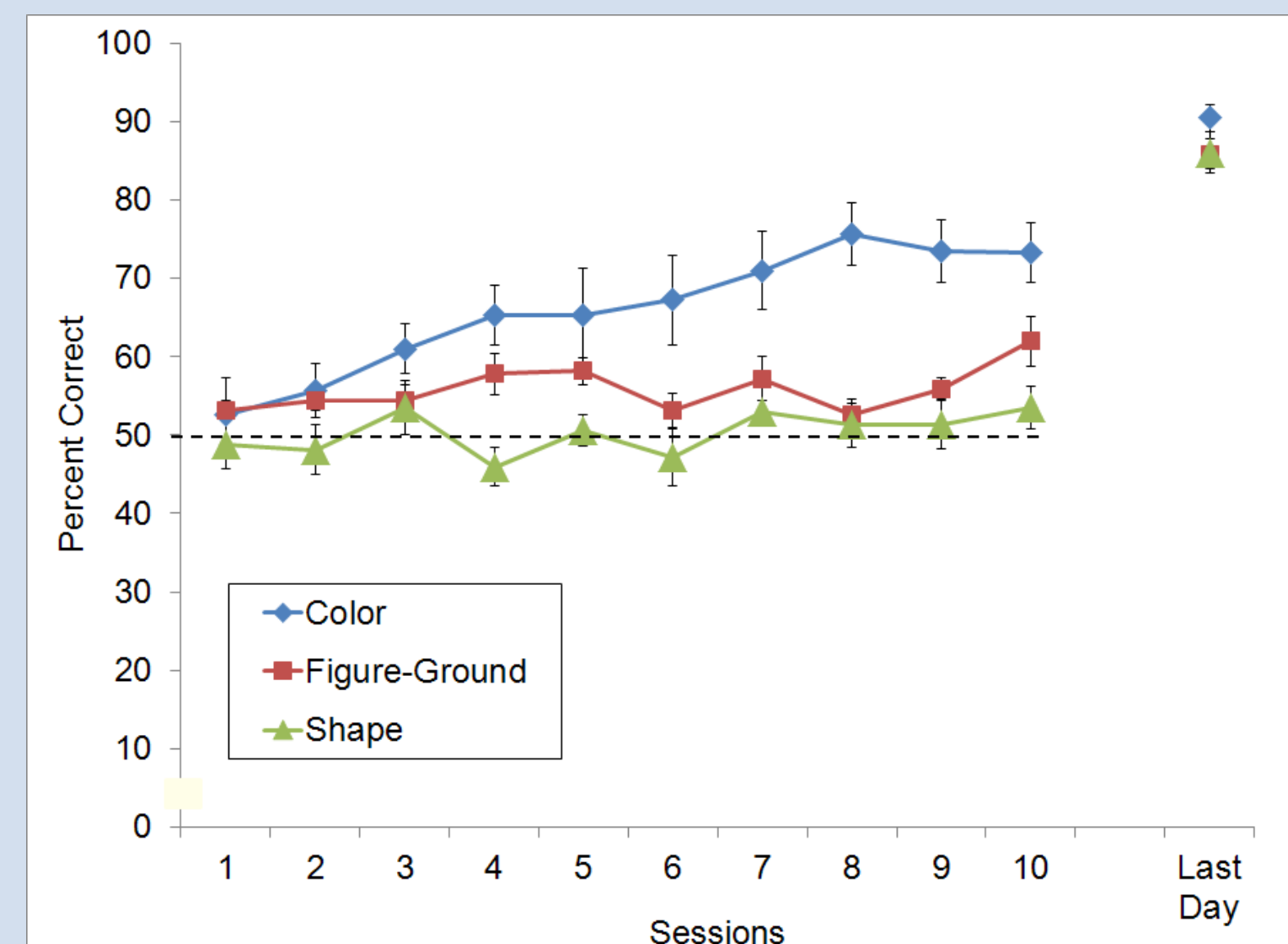
Training
❖ Different speed of acquisition during first 10 days of training
  o Color discrimination is the easiest task
  o Figure-ground discrimination is next
 o Shape discrimination does not differ from chance after 10 days of training

Percent Correct — Sessions — Color, Figure-Ground, Shape — Last Day

❖ Implemented additional shape training
  o Three sessions of shape trials followed by a session with 3 trial types presented simultaneously
 o Repeated when shape discrimination accuracy is at 50% or below
❖ By the end of training, shape is as accurate as figure-ground

### Effect of lesion of n. subpretectalis
❖ No effect in sham group

Sham Group — Percent Correct — Before / After — Color, Figure-Ground, Shape
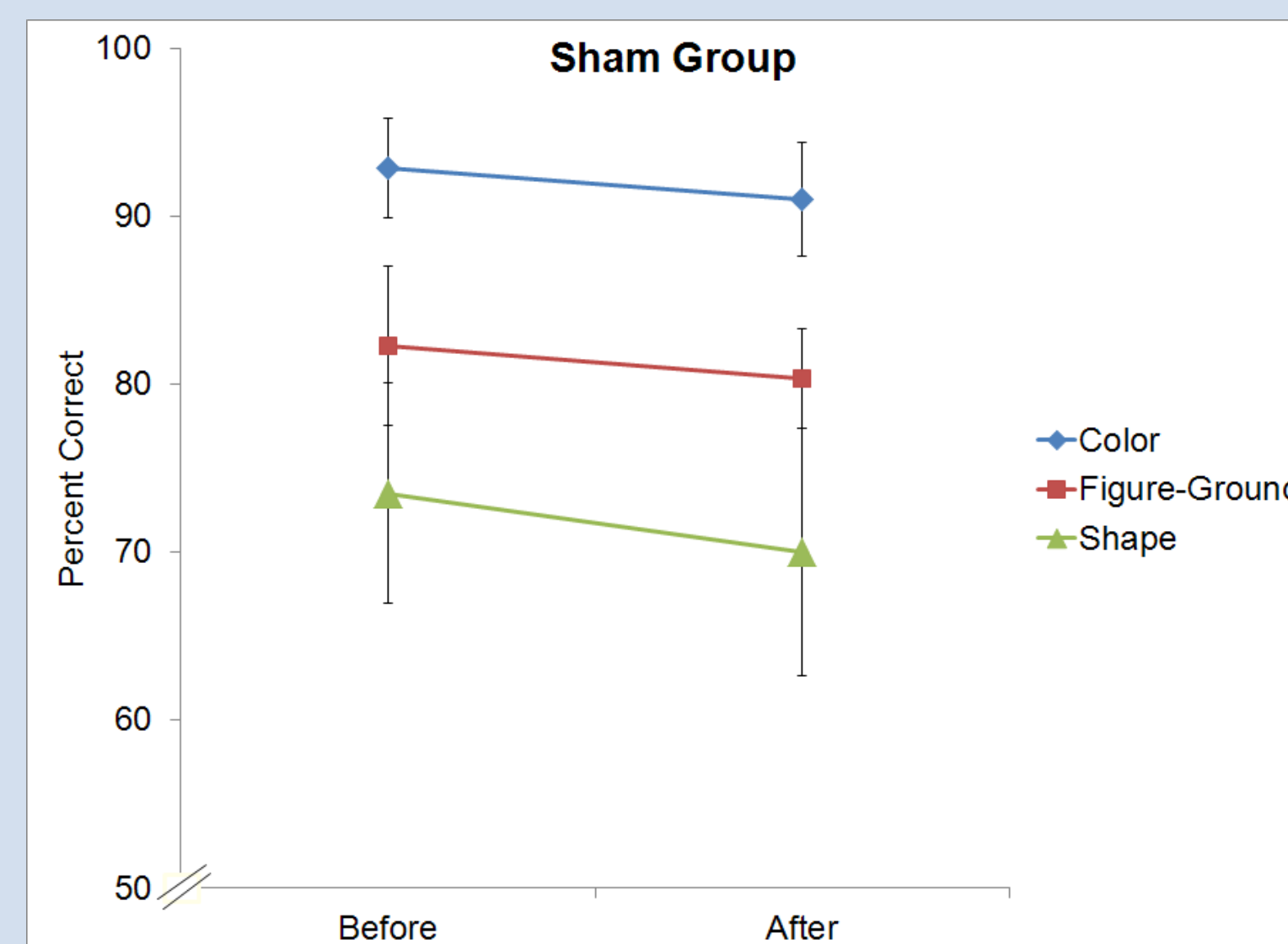
❖ No effect on color discrimination in experimental group
❖ Equal impairment in figure-ground discrimination and shape discrimination

Experimental Group — Percent Correct — Before / After — Color, Figure-Ground, Shape
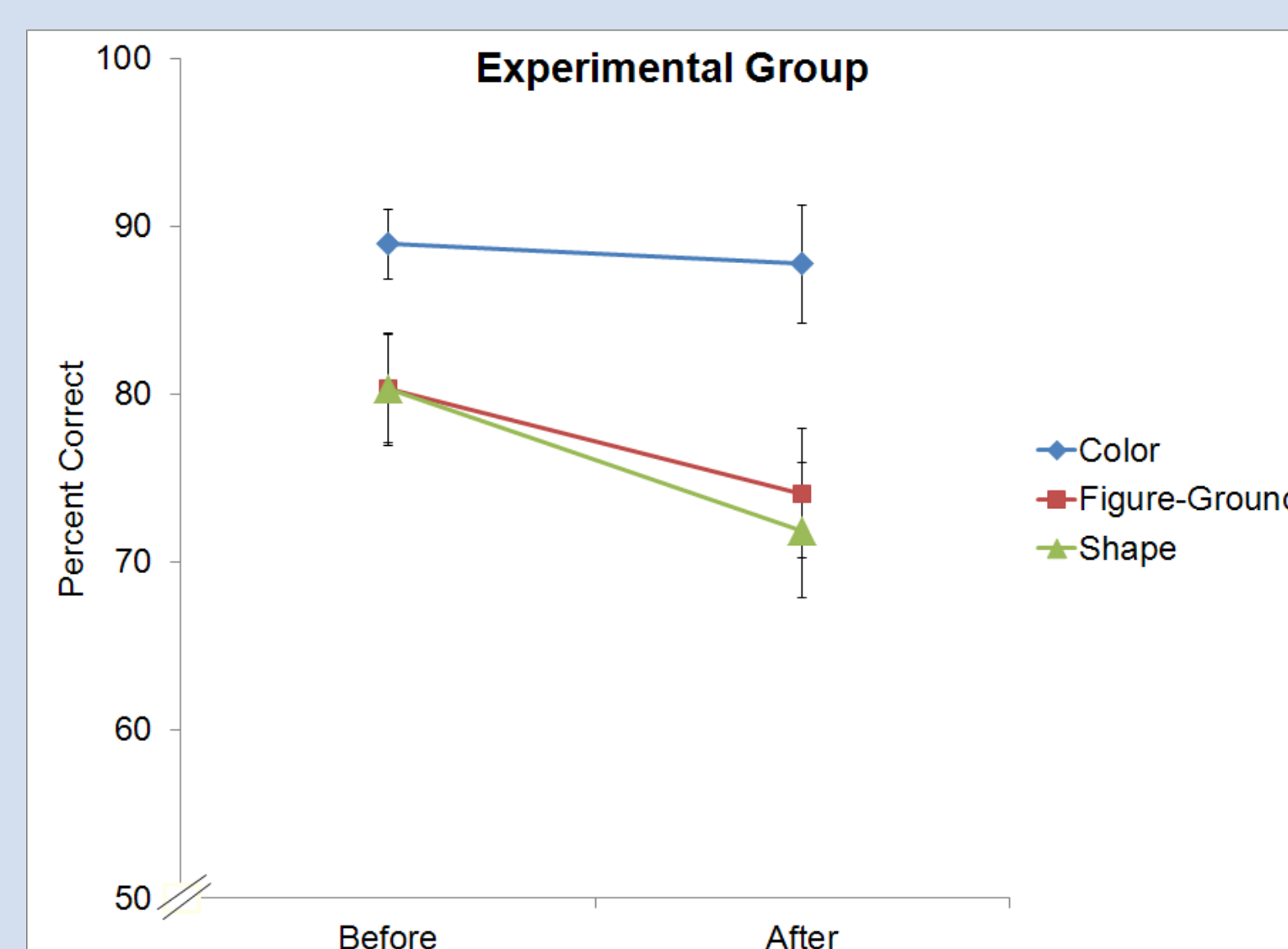
Histology
❖ Currently, measuring the volume of lesion in experimental group to correlate with discriminative performance

Sham   SP/IPS lesion
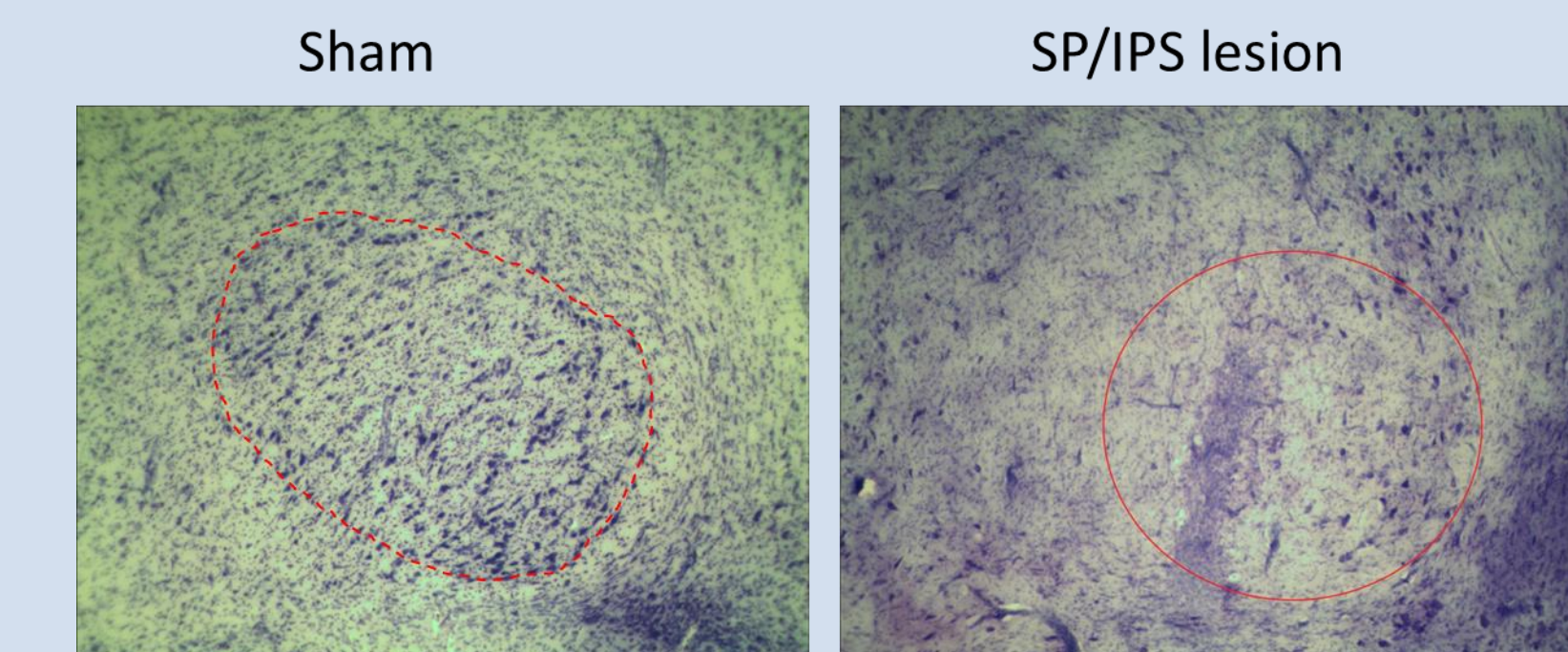
Summary and future research

❖ Bilateral lesion of SP/IPS differentially impairs three discriminations

❖ Color discrimination is unimpaired
  o Even though Rt contains neurons sensitive to color (Wang, Jiang, & Frost, 1993)

❖ Both shape discrimination and figure-ground discrimination are equally impaired

❖ Our earlier study (Acerbo et al., submitted) demonstrated that figure-ground discrimination is associated with a high activity of SP/IPS and Rt but shape discrimination is not

❖ Together, these results suggest that Rt and SP/IPS are key structures involved in figure-ground assignment
  o Thalamic nuclei instead of cortical structures (striate cortex) as in mammals

❖ The impairment of shape discrimination is likely due to distortion of visual information transmitted through Rt to higher-level areas

❖ Next, we will explore the effect of pharmacological blockade of specific receptors in SP/IPS on figure-ground discrimination
  o Glutamate (projections to SP/IPS from optic tectum) and GABA (projections from SP/IPS to Rt)
  o Supported by 2012 DUSCI's Summer Research Fellowship to Erin Scully

References

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