

P039a-c – Innate Pigeon Aversion to Eye Stimuli Spectrum

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1: Introduction

Fear is very important to the survival and evolutionary success of animals. If animals of a lower trophic level can better recognize threatening animals, the aversive emotion of fear can modulate motivational state and increase chances of survival. This can occur through staying hyper-aware of their surroundings, strategically hiding from threatening predators, and preparing the body for a flight response. Fear is an important part of evolutionary survivability caused by threatening stimuli, so much though that unconditioned fear can even be, in part, “genetically hardwired” into the behavior of animals across generations independent of experience. For example, Fanselow & Hoffman (2024) argue that unconditioned fears are examples of a species-specific defense reaction (SSDR) that has evolved over time. For example, a study by Cook and Mineka (1990) demonstrates the effects of SSDRs in associative learning by showing that rhesus monkeys will develop fear association of a novel digital snake stimulus at a faster rate compared to a novel silk flower stimulus. These Rhesus monkeys were exposed equally to both types of stimuli yet fear conditioning—measured through behavioral fear responses like freezing, retreating, and refusal to approach the stimulus—was much faster and stronger in the snake trials compared to the flower stimuli, despite these captive rhesus monkeys never before encountering either stimulus. These results emphasize the concept that there is a biological predisposition for certain fear associations, which is a subject of significant scientific interest in our study.

These ideas of unconditioned fear and SSDRs are not isolated to primates but have been shown in a variety of other organisms. Hermit crabs, for example, show an unconditioned fear

response to a digital looming stimulus, despite no explicit exposure to the physical stimuli themselves or negative outcomes (Shragai et al., 2017). Many birds have also been shown to show unconditioned fear responses to various dangerous stimuli (Blumstein, 2006), and the biological mechanisms that drive fear responses in birds are well-established. De Haas (2012) positively correlated “freezing” behavior with higher corticosterone (cortisol) levels in chickens. These experiments support the hypothesis that while fear can be measured in birds externally through experimentation, there is an underlying, biological basis for predispositions of fears. A review by Papini et al. (2018) delves further into the bases of unconditioned and learned avian fear. Despite its popularity of research, some characteristics that facilitate an unconditioned fear response and SSDRs have yet to be explored. Although unconditioned fears have been established, the extent and detail at which SSDRs are encoded remains unclear.

One of these detailed characteristics that drive fear responses may be the specific orientation of eyes. An interesting characteristic that differentiates low from high trophic level organisms is the specific orientation of their eyes. Organisms of a lower trophic level – cows, pigeons, rabbits, and zebras – have eyes on the sides of their heads to maximize peripheral vision, while those more superior in the food chain have eyes closer to the center of their face for a more focused line of sight and binocular vision – felids, canids, birds of prey, insectivorous primates, and humans (see Figure 1 for illustration). Visual predators often have a greater demand for detailed binocular vision focused on tracking and hunting a moving target, while prey species have a greater demand on monitoring their entire surrounding environment for predators and other threats. These differences in evolutionary pressure evolutionarily have driven the phylogeny of eye orientation (Nilsson, 2013).



Figure 1. - Comparison of eye-gaze direction between high trophic level (left; lion) and low trophic level organism (right; pigeon).

Studies have shown that birds are sensitive and fearful of eye stimuli. For example, *Sturnus vulgaris* (starlings) are sensitive to the gaze direction of a predator, which can be reflected in their preferential feeding behavior (Carter et al., 2008). This fear of eyes is so widespread that some animals, like butterflies, have even evolved mimicked eye-adjacent stimuli that deter avian predators. A study by De Bona et al., (2015) touched upon this idea by investigating fear responses elicited by butterfly eyespots in *Parus major* (Great tits). Bona et al. tracked five different fear responses in these birds - “no response”, “stare”, “explore”, “startle”, and “flee”. “Nodes”, or groups, were created to then provide scores to each of these responses. Node n1 was used primarily to score the presence or absence of a reaction, with a score of 0 for “no reaction” and a score of 1 for the presence of any reaction. Subsequently, they characterized any present responses to a numerical value (node n2), assigning aversive responses (startle and flee) to a value of 1 while assigning non-aversive responses (stare and explore) to a value of 0. Within the categories of “aversive” (node n4) and “non-aversive” (node n3), the stronger response (“flee” and “explore”, respectively) was given a score of 1, and the weaker was given a score of 0. In node n2, eye mimicry on the butterfly exteriors led to a higher score, indicating a higher level of aversion. Similarly, in node n4, a significant trend was found for the eye-adjacent

stimuli inducing both a stronger level of aversion (fleeing) and a weaker level of interest (staring) as compared to the non-eye-adjacent stimuli. Ultimately, De Bona et al. (2015) demonstrated that tits displayed higher levels of aversion to equally contrasting and colorful eye-adjacent stimuli than to matching non-eye-adjacent stimuli. The researchers posited that organisms with eye-adjacent markings on them were therefore much more effective at deterring attacks from predatory birds than were non-eye-adjacent markings. As a control, the authors also showed that Great tit's fear responses elicited by the eyespots were shown to cause a similar fear response as owl eye stimuli alone. Through this investigation, De Bona et al. (2015) substantiated the hypothesis that some birds possess an unconditioned aversion to eye stimuli, even if they are not attached to a predator. Whether or not the specific eye orientations of predators' eyes trigger a fear response, however, is unknown.

We were interested in studying whether the position of digital eye stimuli impacted both fear and unconditioned aversion in pigeons. During a previous experiment in our lab ("P035A - Fast Object Association Mapping by Inference of Exclusion in Pigeon Models") pigeons were exposed to a "lollipop" stimulus that resembled two eyes (an oval with a "pupil" in the middle). During trials with that stimulus, we noticed that a select few subjects (Yoshi and Athena) showed a decrease in response accuracy (Figure 2), indicating that they may have been actively avoiding the images of the eyes. Because responses were reinforced with food, and yet accuracy had still decreased, behavior suggested that the pigeons were experiencing an unconditioned aversive response to the "lollipop" (eye) stimulus.

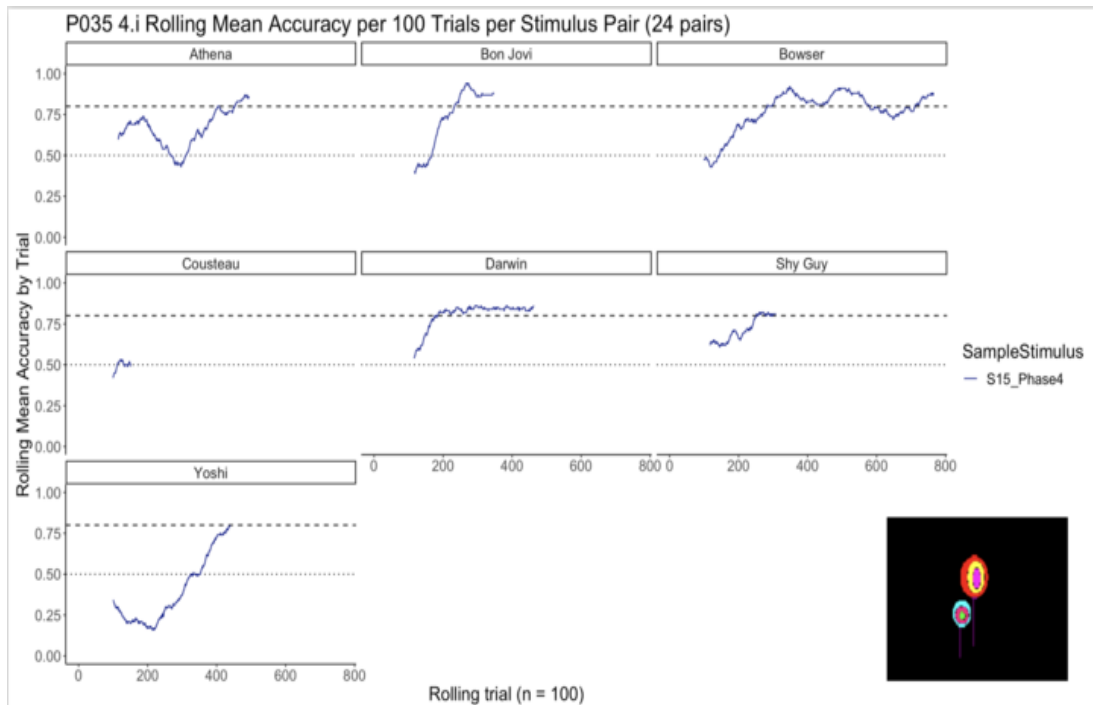


Figure 2. - Mean accuracy of responses of seven different subjects in P035 when exposed to “lollipop” stimuli (inset bottom right). See P035 manuscript for more details. Until about the 250th trial, Yoshi and Athena underwent a decrease in their accuracy of responses. While their accuracy did appear to improve significantly after this mark, its decrease prior to this point likely indicates that there is some element of avoidance of the stimulus taking place.

But which characteristic of the stimulus is responsible for causing the subjects to react in this manner? Did the width between both eyes or their relative placement in space have any effect on the pigeons’ avoidance? We investigated whether a simple line drawing of a pair of round novel eye-like stimuli would unconditionally elicit avoidance. Furthermore, we varied the distance between the pair of eyes to determine its role in aversive responding. Would more predator-like eyes (closer together) elicit stronger avoidance than more prey-like eyes (set further apart)? To evaluate these hypothesized predictions, we measured response rates and reaction times to these “eye” stimuli compared to control stimuli lacking eye features.

2: Materials and Methods

2.1 Subjects

Four unique adult pigeons (*Columba livia*) served as subjects ($n = 4$) during each pilot phase. All pigeons were maintained at 80-85% of their free-feeding body weights throughout the experiments and were given constant access to grit and water in their home cages. Each pigeon was housed individually in steel home cages with wire mesh floors. The colony room was maintained on a 12-hour light-dark cycle with testing occurring during the light portion of the cycle.

2.2 Apparatus

Chambers used in the experiment were six Plexiglas boxes (38-cm wide x 36-cm deep x 38-cm high). The back panel of the chamber was a color LCD monitor (NEX MultiSync LCD 1550M; screen 30.5 cm x 21.6 cm) that displayed the stimuli to the subjects. Stimuli were presented on the monitor through the coding language Python3 (Python Software Foundation, <https://www.python.org/>). Interaction with the display monitor was detected by an infrared touchscreen (Carrol Touch, Elotouch Systems, Fremont, CA) that was mounted approximately 18mm from the monitor screen. A custom-built food hopper (Pololu, Robotics and Electronics, Las Vegas, NV) located at the center of the back panel was operated and recorded by a personal computer operating Windows 10. An access hole positioned below the monitor provided access to grain when the hopper was elevated. Access to the food hopper resulted as a reward for correct responses. Adjustable white LED-strip lights (Phopollo 16.4 ft) were placed along the roof of the box for optimal lighting. Two cameras were placed inside of the box, one was a 120-degree 1080p FOV wide angle Camera (Spedal, CMOS), the other a Raspberry Pi camera. Both cameras

captured video at a relatively consistent FPS varying between 33-37, with the wide-angle camera placed downwards from the roof, and the RPi camera placed on the side wall of the box.

2.3 Stimuli

There were two classes of stimuli used: training stimuli and probe-test eye stimuli. All possible traits of stimulus characteristics (i.e., color, surface area, shape distribution) were controlled for across these stimulus classes such that the only thing that differed was the presence/absence of eyes. All stimuli featured a combination of blue (#2596be), yellow (#e8d24c), and dark brown (#31131e) coloration. Each color was equally present between all stimuli in both classes: there were ~40,500 blue pixels ($\pm 3,500$ p²), ~11,000 yellow pixels (± 830 p²), and ~1,800 dark brown pixels (± 100 p²). The background of each stimulus would match the overall background color of the experimental program with a dull grey color (#7F7F7F). Each stimulus also contained the same number of sub-shapes (see Table 1). It is important to note that the stimuli dimensions provided correspond to those of the initial pilot phase, and in the third and final pilot phase, these numbers were scaled down by a factor near 10. This would allow for subjects' FOV to actually contain the entire stimulus. The software tool "ImageJ" was used to measure, compare, and set spatial dimensions of all stimuli. Multi-factor control of training stimuli was inspired by Brannon & Terrace (2000).

Probe eye stimuli consisted of two sets of two concentric circles ("eyes") that were placed side-by-side atop a square blue "head" stimulus (see Table 1, row 1 for visualization). Exact colors and iris/pupil shape orientations were chosen to model *Glaucidium passerinum* (pygmy owl) eyes, which are common predators of pigeons and were the fear-inducing owl stimuli used in De Bona et al. (2015). We generated a stimulus set of five different probe eye

stimuli, where the relative distance between the eyes/center point of the head systematically varied on a spectrum from very far apart (prey-like) to very close (predator-like). The relative distance between eyes is hereafter called eye “orientation.” To ensure we maintained consistency within the probe stimulus set, the color of the stimuli, eye shape, eye size, and relative number of colored pixels remained identical across each of the five probe stimuli. However, there was a slight difference in number of blue head pixels as the eyes overlapped more of the head (~18.5% less blue in P5 compared to P1).

There were 25 total training stimuli. These training stimuli were carefully generated to mirror the probe stimuli in all possible ways except for representation of eyes. To mirror the way that the five eye probe stimuli varied from each other in relative orientation of a sub-shapes (e.g., head, pupil, and iris), training stimuli were split into five distinct sets of five stimuli each (see Table 1 for visualization of all stimuli). Each set contained three types of shapes: one large blue shape in the background, two medium yellow shapes in the midground, and two small brown shapes in the foreground (5 total shapes). The relative orientation of shapes within each set varied from stimuli to stimuli, sometimes randomly (Table 1, Training Set 1; T1.1-T1.5) and sometimes functionally to mirror the functional changes in the probe stimulus set (Table 1, Training Set 2; T2.1-T2.5). However, orientations and overlap of sub-shapes never approached the same orientation as the probe set and, therefore, did not model eyes.

After the initial pilot, we decided to implement a side-bias elimination phase that consisted of stimuli that were essentially 20% filled in circles. These stimuli varied between 6 different colors with the following hexcodes: #77FF00, #FF8100, #D5869D, #902090, #FF1100, #6B4330.

All shapes featured a 3-pixel black outline around them to increase contrast. A receptive field surrounded 10p around each stimulus where any peck within the field rendered the same response as a peck within the bounds of the stimulus.




















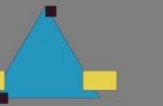








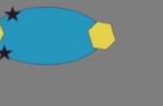

		Stimulus Number				
		1	2	3	4	5
Probe Stimuli						
Training Set Number	TS1					
	TS2					
	TS3					
	TS4					
	TS5					

Table 1. Table containing all stimuli sets used, including probe “eye” stimuli (row 1) and training stimuli used in P039a. Number of colored pixels and shapes remained similar across all stimuli within a set buffer (see text for details).

2.4 General Methods

Our primary goal was to investigate whether stimulus aversion differed as a function of eye proximity. We ran two different types of experimental sessions: 1) a mixed autoshaping/instrumental contingency and 2) a preferential choice task. Prior to the initial autoshaping sessions, we ran a pre-training procedure to ensure that subjects were responsive to neutral stimuli on the screen with the identical blue (#2596be) color to our probe and control stimuli. The pre-training stimulus consisted of an irregular polygon shape and did not change between pre-training trials. Regarding timing of intervals and reinforcement schedule, the pre-training procedure mirrored that of the auto-shaping phase (RR5, with the stimulus appearing 10 seconds after the grey screen was initially displayed). Many subjects had not participated in trials for elongated periods of time prior to the onset of this experiment, so it was critical to allow them to regain familiarity with the apparatus and experimental environment. Sessions were run until subjects habituated to eye stimuli (usually ~4 consecutive sessions). We recorded each experimental session and timestamped each trial, which, if the experimental data showed an effect, would allow us to train a pose estimation algorithm (DeepLabCut; pigeon supermodel) to differentiate body attributes and analyze video footage of relevant trials.

2.4.1 Experiment 1: Mixed Autoshaping/Instrumental Methods

The first experiment utilized a mixed autoshaping/instrumental procedure. Each trial began with a grey (#7F7F7F) screen for 10 s, after which a single neutral stimulus would appear in the middle of the screen. Food reinforcement was provided after the 30s interval concluded or immediately following five pecks on average (RR5, bound between 3 and 7) at the presented stimulus; pigeons could only receive a single reward per trial. A variable ITI (between 10 - 20 s)

separated trials to avoid prediction effects. Because 12 stimuli were being used (10 control – 2 from each training set - and 2 probe) there were a total of 84 trials in each session to ensure that each stimulus was shown exactly seven times. Within each “batch” of 12 trials (i.e. trials 1-12, 13-24, etc.) two stimuli from each training set as well as both probe stimuli were shown. To determine any initial aversion to eyes, only P1 and P5 were utilized for this auto-shaping procedure. If an effect was determined, only then would the rest of the probe stimuli spectrum be utilized. Probe trials were identical to neutral stimuli trials in schedule and timing of reinforcement. For the first 30 trials of each session, there were 5 consecutive control trials, followed by 1 probe trial, followed by 5 consecutive control trials once again, and so on. Across sessions, the order of trials was random, but ultimately the 84-trial sequence would consist of the same frequencies of stimuli shown. If the eye probe stimuli elicit fear unconditionally, we might expect to see more fear-like responses in early trials. Particularly, the first probe trial for each subject was of heightened interest. If there was to be an innate aversive response to either P1 or P5, it would be apparent upon initial presentation of the stimulus to the subject. Training stimuli were always selected via quasi-random sampling without replacement from the sample set of 12; no more than two of stimuli of the same training set were shown consecutively.

The bank of 10 training stimuli was utilized to both slow down the rate of habituation to stimuli and to minimize neophobia effects. All stimuli, both training and probe, were presented at the same frequency within each session: seven times each. Trial order differed, but all stimuli were novel to the same extent. This mitigated any differences between stimuli that might be caused by non-eye factors, such as neophobic-based aversion. Colors, shape frequency, and differences across training stimulus sets were identical to the probe stimulus set, such that the only thing that differed across them was the presence or absence of eyes. Therefore, we could

effectively determine that any differences in aversion behavior between probe and training stimuli could be attributed only this difference. The systemic differences across training stimulus sets also enabled us to make robust inferences about effects of predator-like and prey-like probe stimuli.

Classically, the pigeons would associate the cue with food reward and quickly peck at the cue through a sign-tracking response (Brown & Jenkins, 1968), thus exhibiting associations between cue, response, and food. We expect to see less interaction (and perhaps slower learning) upon stimuli that are innately more fearful to the pigeons (i.e., predator-like eyes). Mixed autoshaping/instrumental sessions concluded after 84 trials were completed or 90 minutes elapsed, whichever came first. Daily sessions continued in the same quasi-random trial structure until pigeons earned preemptive reinforcement for all trial types (~5 sessions). Initially, only four subjects were used to pilot the procedure but, once the procedure was crystalized, an additional six pigeons may be added for a total of ten. This would enable better counterbalancing as well.

Bird Name	First Probe	Second Probe	Third Probe	Fourth Probe	Fifth Probe
B1	P1	P5	P2	P3	P4
B2	P1	P5	P4	P3	P2
B3	P5	P1	P2	P3	P4
B4	P5	P1	P4	P3	P2

Table 2. Counterbalancing probe trial schedule for birds 1-12 for the first five probe trials of each session. This schedule was maintained across consecutive sessions.

2.4.2 Choice Task Methods

After the autoshaping/instrumental training procedure was completed and all pigeons were pecking at each of the probe stimuli, pigeons were presented with a choice procedure. These different components of the choice task were enforced to gauge relative aversiveness between different eye orientations, aversiveness towards eyes to begin with, and no preference otherwise, respectively. The same two probe stimuli that were used in Phase 1 were used in Phase 2. All training stimuli that were used were of Training Set 5 (TS5), as this set's stimuli possessed a similar method of variation to the probe stimuli set, with a larger, static blue shape in the background and smaller yellow and black shapes in the foreground that varied in a controlled manner around the circumference of the blue oval.

After the initial pilot, subjects displayed a heavy side bias to whichever side they fixated on during Trial #1 for each session. Wario, for example, selected the left stimulus on Trial #1 and was reinforced, so the left stimulus was then selected in all subsequent trials. To mitigate this, "Side Bias Elimination Trials" (SBE) were added to the choice task procedure for the second pilot version of the program. SBE trials consisted of the same stimulus as in the pre-training procedure (a circle with 20% of its circumference filled in) except two such stimuli were now shown on the left and right sides of the display. The "correct" (reinforced) answer had a 50% chance of being the right stimulus, as well as a 50% chance of being the left stimulus on each trial. Overall, each session consisted of an equal amount of left and right reinforced trials. If the "correct" stimulus was chosen, subjects were reinforced. Otherwise, a 1-s ITI, followed by display of the exact same trial as the previous trial was shown, which functioned as our correction procedure. The purpose of this correction procedure was to eliminate any side bias that was present and force subjects to explore both answer choices as potentially "correct". If the "correct" choice was selected, subjects moved onto the next SBE or regular choice-task trial.

Each choice-task session began with multiple SBE trials (with two different colors of SBE stimuli shown) followed by the first choice-task trial. Within each of these choice-task trials, the pigeon was presented with one of three different types of choices – probe stimulus vs. probe stimulus, probe stimulus vs. training stimulus, or training stimulus vs. training stimulus. In the SBE trials, pigeons were required to peck on one of the two stimuli exactly 10 times (FR10) to receive 4-5s of food access as a reward. For the choice-task trials, the same FR10 schedule was maintained, but reinforcement was not provided. A 20-s ITI separated choice trials. After the first choice-task trial, future choice-task trials were interspersed between a random amount of 4-7 SBE trials. Gaps of 4, 5, 6, and 7 trials between choice-task trials each took place three times in the 81 total trials in the session. After the final (12th) choice-task trial, three SBE trials were provided, and the session subsequently ended. Ideally, this implementation of SBE trials would eliminate any present side bias from subjects, and the choice-task trials would reflect this.

3: Results

To measure relative level of fear to probe stimuli, we focused on four sets of DV's: spatial orientation of pecks (peck accuracy and variance: measured as the vector distance between the point of interaction on the screen and the center of the respective stimuli), temporal information (e.g., latency to first peck and interpeck interval), choice preference, and video footage of behavior. Spatial orientation of pecks will include the accuracy of pecks, measured by the distance between the center of the respective stimulus and the peck coordinates; a higher level of accuracy would reflect a lower level of aversion to a certain stimulus. We also may be able to analyze spatial and temporal variance of pecking to make inferences about expectation of reward (Gharib et al., 2004; Stahlman et al., 2010). Bout analysis will focus on quantifying the

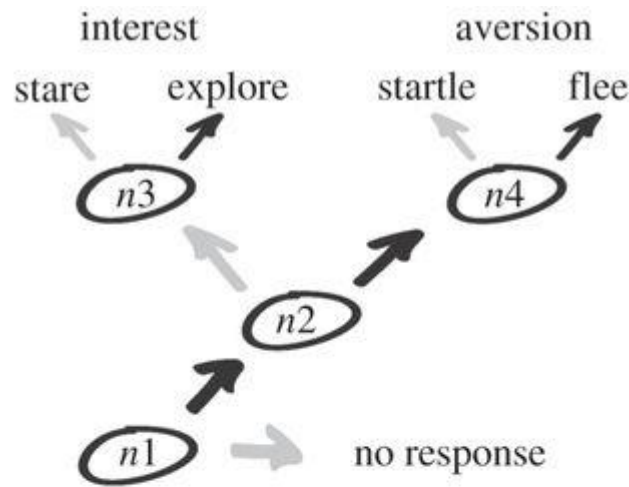
length, speed, and inner-response interval speed at which the pigeons were pecking. Generally, both a higher frequency and a higher speed of pecking would indicate a lower level of aversion to that respective stimulus, while infrequent and slower responses might signify aversiveness. Choice preference was included to gauge relative level of aversion to each stimulus, with the expectation that pigeons would select the “lesser of two evils” between aversive probe stimuli (e.g., probe lower on the trophic spectrum).

Previous experiments have shown direct eye-gaze to be aversive (Carter et al., 2008), which we expect to attain similar data in our study. Low trophic-level “prey-like” probe stimuli (P1, P2) should, in theory, yield significantly lower response latencies, higher response rates, and higher choice rates compared to high trophic-level “predator like” probe stimuli (P4, P5). We expect to see some sort of initial aversion to the all probe stimuli and a lowered response rate compared to the neutral stimulus, based on the general presence of eyes. However, we may see no difference between training stimuli and prey-like eyes (P1). Since this is the first time pigeons are encountering these stimuli, we wanted to gauge initial response and reaction before conditioning has occurred.

In addition to the touchscreen DVs mentioned above, we will also adopt a similar behavioral hand-scoring technique that was utilized in De Bona et al. (2015). All experimental sessions will be recorded, and responses to stimuli will be categorized into five different types of responses: “no response”, “stare”, “explore”, “startle”, and “flee”. We also will adapt the node approach, with n1 determining whether or not there is any response, n2 determining whether or not the response is considered aversive or non-aversive, and n3 determining the severity of this response, with “explore” and “flee” considered more severe and “stare” and “startle” considered

less severe (see Figure 3). This node scoring will assist in the quantitative comparison of behavior across high (P5) and low (P1) trophic trial types.

An alternative to hand scoring will be usage of the pose estimation algorithm DeepLabCut which will be used to derive spatial points from recorded session footage. The PigeonSuperModel trained by Hidalgo & Möser (2023) will be utilized to quantify behavior. Behavior across high to low trophic-level eyes trials types will be directly compared in the hopes of uncovering unexpected behavioral differences. Different classification of behaviors may be derived from De Bona et al. (2015).



category	vector			
	<i>n1</i>	<i>n2</i>	<i>n3</i>	<i>n4</i>
no response	0	n.a.	n.a.	n.a.
stare	1	0	0	n.a.
explore	1	0	1	n.a.
startle	1	1	n.a.	0
flee	1	1	n.a.	1

Figure 3. - Binomial tree adapted from De Bona et al. (2015). Binomial scores given for each response were either ‘0’ or ‘1’. Description from De Bona et al. (2015) “Structure of the binomial tree leading to the four behavioral response categories recorded. Circles represent binomial nodes with the two alternative outcomes coded as 1 (black arrows) or 0 (grey arrows). Table represents the binomial node values necessary to code each categorical outcome.” We will adopt our own metric from experimental behavior once it is collected.”

After post-experiment data analysis was completed succeeding the final pilot version of the experiment (P039c), null results were obtained across all variables. This is exemplified in *Figure 4*, which displays just one of our variables (choice preference) within PvC trials in the choice task phase, and illustrates that there was no apparent preference between the probe and control stimuli for all birds. *Figure 5* illustrates a similar null effect, except this time within the PvP trials, which aimed to evaluate aversion on a “spectrum”.

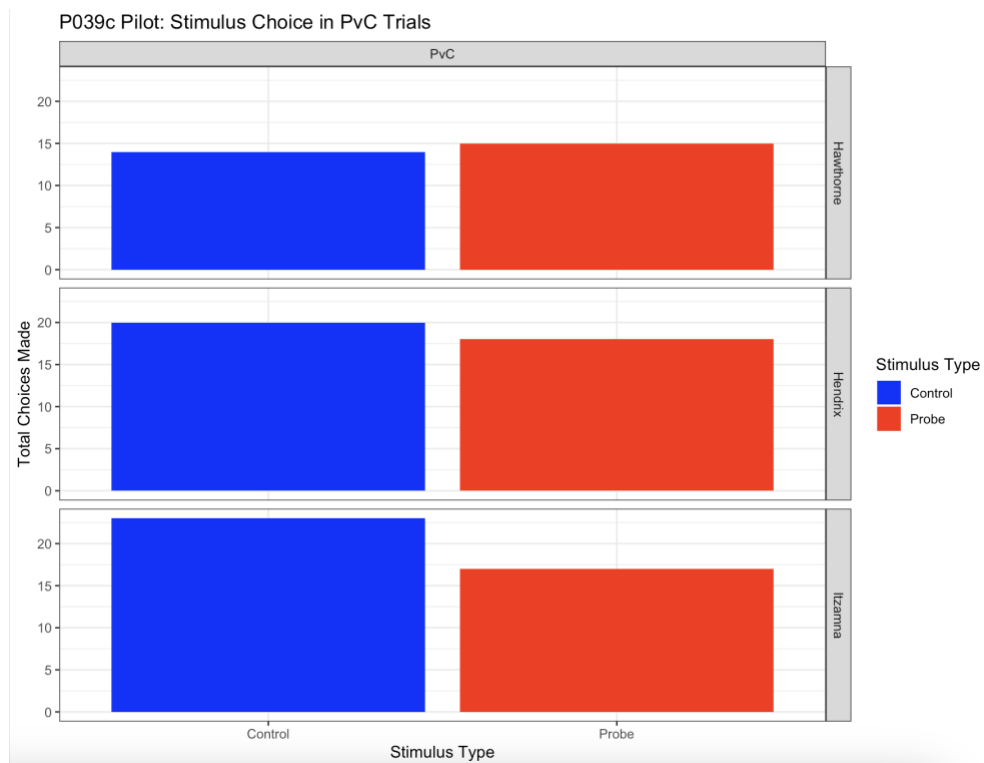


Figure 4. – Total choices made for three subjects (Hawthorne, Hendrix, and Itzamna) for all PvC trials throughout all sessions of the choice task. Control choices (in blue) are shown on the left side; probe choices (in red) on the right.

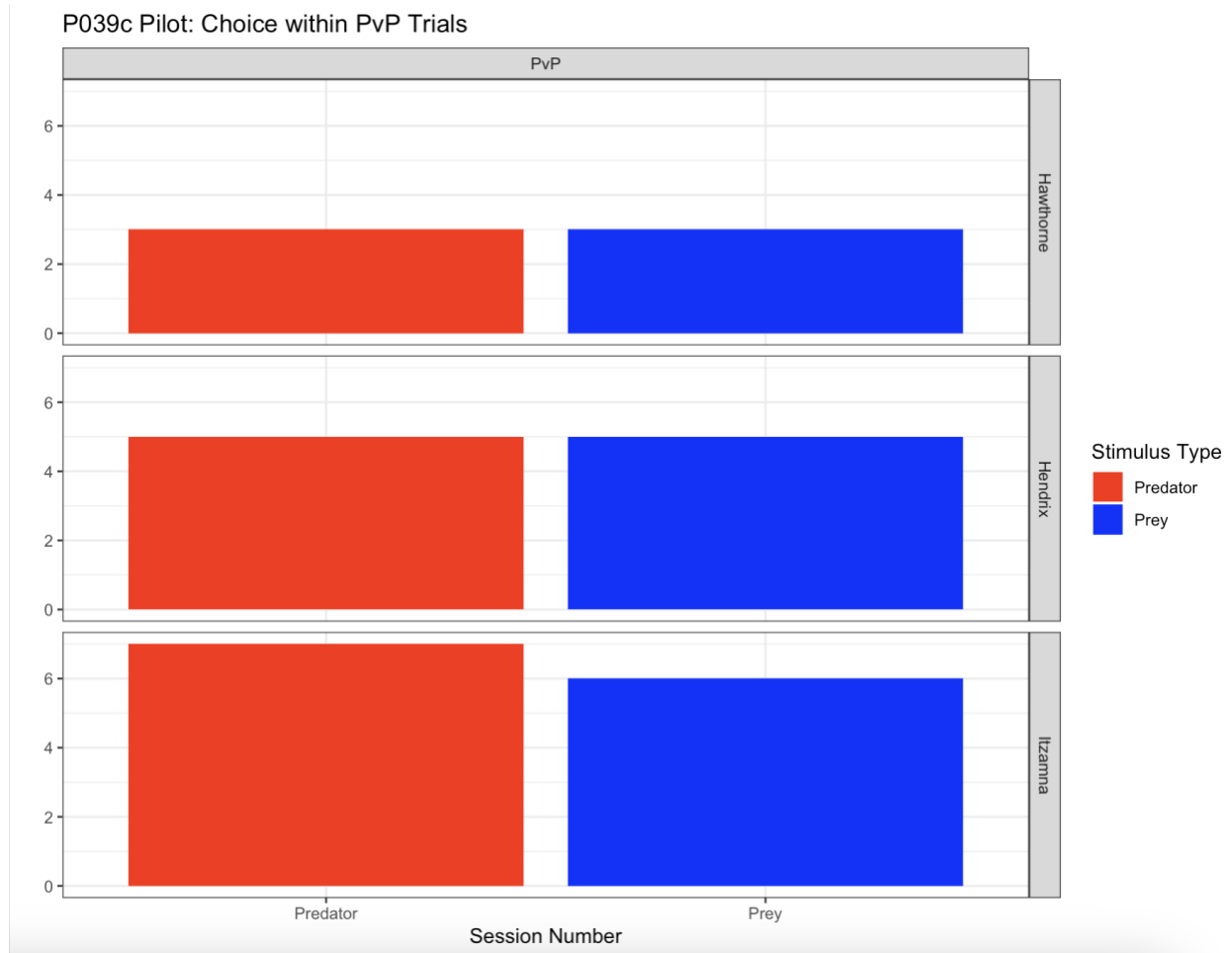


Figure 5. – Total Choices made for the same three subjects (Hawthorne, Hendrix, and Itzamna) for all PvP trials throughout all sessions of the choice task. Probe stimuli on the “predator” end (eyes close together in the center of the head) are shown on the left side (in red). Probe stimuli on the “prey” end of the continuum (eyes far apart from the center of the head) are shown on the right side (in blue).

Like the choice task results, the autoshaping/instrumental phase also yielded null results for all variables. Birds in the second pilot phase had statistically similar mean trial durations between both probe and control trials (*Figure 6*).

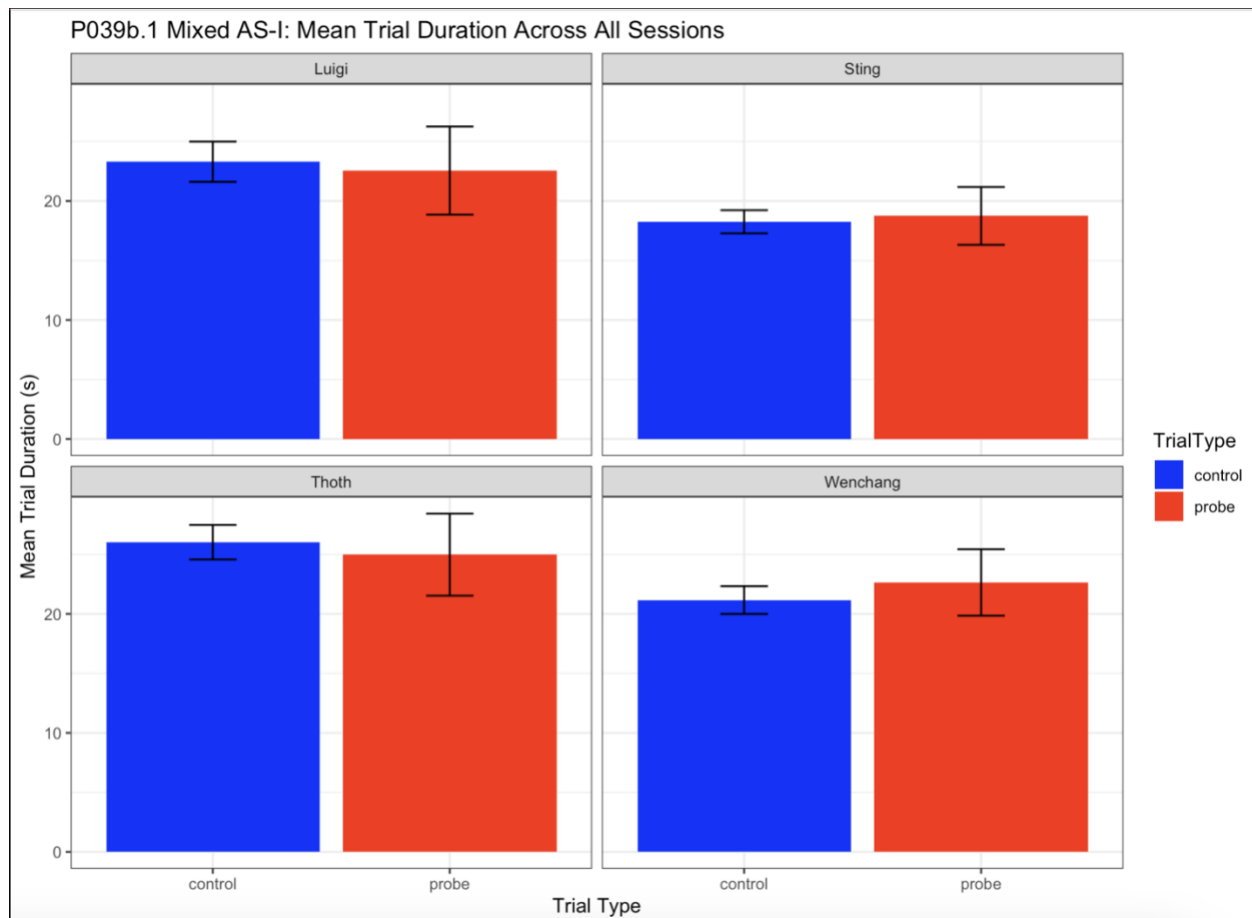


Figure 6. – Mean trial duration across all autoshaping trials for birds in the second pilot phase (Luigi, Sting, Thoth, and Wenchang). Mean trial times for control trials are shown on the left of the graph for each subject (in blue) while trial times for probe trials are shown on the right of the graph for each subject (in red).

Discussion:

Because we could not gauge an effect of eye stimuli on pigeon aversion throughout all versions of this experiment, there is uncertainty as to which potential factor(s) led to the null results. It is likely that the nature of the experiment was not the relevant factor, but rather the stimuli themselves – they were hand-crafted and, perhaps, did not resemble eyes in the perspective of the subjects in the same manner that they resembled eyes to us. Additionally, many of the subjects began to complete trials very quickly after 1-2 sessions, which may indicate that they had fixated on the reward and were not truly assessing the stimuli prior to engaging with them. In the third rendition of the experiment, we tried to implement a couple of key changes, such as decreasing overall stimuli size and lowering its position on the touchscreen, but this did not seem to impact results whatsoever. In a hypothetical fourth version of this experiment, it may be useful to generate stimuli via a Visual-Language Model (VLM), which would allow for heightened detail and eye-like resemblance for more accurate results.

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Additional Information:

Measurements:

Max Blue: 44000 square px

Min Blue: 37000 square px

Yellow: 10000-12000 square px

Black: about 1800-2000 square px

Saved on 720 x 405 jpeg

Ideas:

-3x3 grid (9 spaces) with control stimuli and one/two eye stimuli

-gauge whether pigeons tend to choose their first 7-8 stimuli as the non-eye stimuli