Chew-Toy Color Preference in Kenneled Dogs (*Canis familiaris*)

Terri Wong

Writer's Comment: In Professor Brad Henderson's UWP 104E (Scientific Writing) course, I was told to write an IMRAD-style paper using general principles and data to make my scientific argument. I instantly knew what topic to investigate. I grew up surrounded by pets—from the typical dog to the exotic praying mantis—which led me to become curious about animal behavior. More recently, I've become interested in the welfare of captive dogs and wanted to learn what makes for effective dog enrichment. Specifically, I observed whether dogs, when given the choice, had a selection preference towards a specific color of chew-toy. With every scientific article I examined, it became clear that dogs can discriminate blue and red colors. Through increased interactions with certain colored toys, dogs would reveal a selection preference toward blue and red toys. Although it is a hypothetical study, writing the paper ignited my passion for scientific investigation. One day, I hope to produce authentic research through my graduate studies in animal behavior. I aim not only to research enrichment items, but more importantly to enhance the lives of captive dogs with the results of my studies.

—Terri Wong

Instructor's Comment: Ms. Terri Wong's paper on chew-toy preference in dogs illustrates a savvy mixture of creativity, scientific rigor, and clear and concise writing. The heart and soul of a scientific research paper is refined data. The data spawns informed conclusions based on data-driven logic. It also impacts the paper's rhetorical shape and the presentation vehicles the writer chooses to showcase the data's highs, lows, and trends. This is why one assignment in my UWP 104E Science Writing class involves writing a primary research paper, or IMRAD, based around an original hypothesis

and methodology, a real and viable context, and a hypothetical data set. In technical industry, this activity is known as creating a "straw dog." Several years ago, when Michael Narachi—a UC Davis alumnus in genetics, front-end research leader, and Vice President for Amgen Corporation—visited my UWP 104E classes, he told us that he regularly requires his on-staff scientists to prepare "straw dog" IMRADs as a part of front-end protocol. The purpose of this writing activity is to demonstrate a project's idealized potential, benefit, and profitability—as well as the most efficient and effective path forward. I am now pleased and proud that one of my student's "straw dog" IMRADs is appearing in UC Davis' hallmark undergraduate journal.

—Brad Henderson, University Writing Program

Abstract

Toy enrichment becomes an increasing concern as shelters must decide what toys to purchase that benefit the dogs and produce long-term success. This study examines dog selection of chew-toys in blue, green, yellow, and red colors, revealing whether dogs have a color preference. Previous studies have shown that dogs have peak sensitivities at 480nm (blue) and at 630nm (red). In this study, 20 dogs were monitored on interaction rates with each colored toy. Since dogs have sensitivity toward blue and red lights, and have difficulty discriminating between 500nm to 600 nm (green to yellow), the study hypothesizes an increase in preference for blue and red toys and an infrequent selection of green and yellow toys. The results showed that dogs did prefer blue and red over green and yellow toys. The majority of the dogs chose to interact with the blue toy. When blue was not present, dogs chose red over green and yellow; given green and yellow, subjects had no preference for one over the other. Not only do blue toys get selected more often, the color also leads to long-term interactions. Within the hour, dogs spent a considerable amount of time interested in blue-colored toys, suggesting that dogs do have a color preference for blue.

1. Introduction

Many dogs (*Canis familiaris*) are housed in adoption shelters from just a few days to several months. Shelters have an obligation to maintain a level of enrichment in the captive animal's environment that improves biological functioning (Newberry, 1995).

Toy enrichment becomes an increasing concern as shelters, which are low in funding, must decide what toys to purchase that benefit the dogs and produce long-term success. The purpose of this study is to examine selection preferences of kenneled dogs when given chew-toys of different colors. Popular belief about canine color vision was that it was nonexistent, that dogs are colorblind. However, studies have shown that dogs have binocular, dichromatic vision and can still discriminate between colors by detecting visible wavelengths. The canine retina contains two types of cone photopigment that have spectral peaks between 420 nm and 555 nm (Neitz et al., 1989). Jacobs et al. (1993) revealed one cone pigment with peak sensitivity at 555 nm and the second between 430nm and 435 nm. Further investigation revealed that dogs have a red light sensitivity of 630 nm and a blue light sensitivity close to 480 nm (Grozdanis et al., 2007). Therefore, dogs have trouble distinguishing wavelengths from green to orange light, about 510 nm to 590 nm. So will dogs select certain colors when given the option? Do they have a color preference in toys? If so, what color catches their interest and results in extended play behavior?

Through behavioral testing, this study aims to reveal whether dogs have a selection preference in chew-toys of blue, green, yellow, and red colors. During daily one-hour sessions, 20 dogs were monitored on the number of interactions—i.e., smell, lick, chew, carry, roll, touch, and guarding—that each colored toy received throughout the three-week test period. Since dogs have peak sensitivity toward blue and red lights, the study hypothesizes an increase in preference for blue and red toys. In contrast, dogs will infrequently select green and yellow toys since they have difficulty discriminating wavelengths between 500 to 600 nm. If dogs do have a color preference, adoption shelters can make cost-efficient purchases on toys with a specific color that will enrich the lives of kenneled dogs.

2. Materials and Methods

2.1 Study Site: Observations were conducted at the Coyote Point SPCA, housing over 40 dogs awaiting adoption. Dogs were individually housed in 4' x 6' solitary kennels (24 square feet), set 4" apart. All kennels held the following: water dish, food dish, soft bed, and blanket. Two black boxes, positioned on the ground at the front of each kennel door, were installed to hold and release toys with the push of a remote-con-

trolled trigger. The 8" x 8" x 8" black-sided boxes were placed 2' apart, orienting one on the left and the other on the right side in the subject's line of vision. Release hinges at the top of each box were triggered to open and reveal toys at the same time for every subject. Simultaneously, visual recordings started once toys were revealed and released in each kennel.

2.2 Subjects: 10 male and 10 female healthy, mixed-breed dogs (*Canis familiaris*) between six months to seven years of age were used in this study (see Table 1A). All 20 subjects had prior experience with similar chew-toys used in the study. These chew-toys were not accounted for in the results. Subjects who showed interest in the toy by interacting and playing were observed. Subjects were excluded if they were not of age, were scheduled for adoption within the test period, were unable to interact with the toy (i.e., due to frail teeth, disability, etc.), or were fearful of the toy or the black boxes.

2.3 Toy selection: A total of 40 chew-toys were used: 10 blue, 10 green, 10 yellow, and 10 red. The bone-shaped toys were 6" long, weighing 10.7 oz, large enough for a medium-sized dog to hold in its mouth and light enough to be carried for an extended time. Made of natural rubber, toys were puncture resistant, nontoxic, nonabrasive, and nonsplintering. Each subject was presented two toys during daily sessions. Toy combinations for subjects followed the "Daily Toy Schedule" (DTS), where one male and one female subject received the same toy combination for that day (see Table 1A and 1B). The DTS allowed adequate amounts of data to be collected daily. Control toy combinations were blue/blue, green/green, yellow/yellow, and red/red; subjects had no need to discriminate between colors since the pairs were the same color. The experimental toy combinations consisted of any combinations of two different colors (i.e., blue/red, green/yellow, red/yellow, blue/green, etc.).

2.4 Interaction and data collection: Toy combinations were presented for 60 minutes each day for a period of three weeks. The one hour sessions occurred at 10:00 A.M., 2:00 P.M., or 7:00 PM. For this study exact starting time of presentation did not matter, as long as all toys were presented to the 20 subjects at the same start-time for each session. Observational data of each session was collected by camcorder record-

ings during the test period. Recordings were digitized and filed through computer software for later analysis.

Table 1A: Daily Toy Schedule (DTS). The assigned toy combination each day of the week for a pair of dogs, one male and one female.

Subjects		**Daily Toy Schedule (Each Week)**						
Male	**Female**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Aladdin	Jasmine	1	2	3	4	5	6	7
Peter Pan	Tinkerbell	10	1	2	3	4	5	6
Sebastian	Ariel	9	10	1	2	3	4	5
Bruno	Cinderella	8	9	10	1	2	3	4
Mushu	Mulan	7	8	9	10	1	2	3
Hercules	Meg	6	7	8	9	10	1	2
Simba	Nala	5	6	7	8	9	10	1
Mickey	Minnie	4	5	6	7	8	9	10
Pongo	Perdy	3	4	5	6	7	8	9
Tramp	Lady	2	3	4	5	6	7	8

Table 1B: Toy combinations are numbered 1 through 10: blue (B), green (G), yellow (Y), red (R)

Code	**Toy Combination**
1	BB
2	RG
3	GG
4	BR
5	YY
6	BG
7	RR
8	BY
9	RY
10	GY

2.5 Procedure: In preparation for each session, a technician followed the DTS and placed one toy in the left black box and the other in

the right. After all toys were in place, the technician pressed the remote-control trigger, which released the hinge of the boxes and revealed the toy combinations for each subject. Simultaneously, the cameras began recording for exactly one hour. After the session, toys were collected from each kennel and placed through a trace-free wash, removing any contaminants left over by the previous user. Toys remained in the wash overnight and were later dried for the next session. The process was repeated for three weeks.

3. Results

3.1 Color preference: A Mann-Whitney U-test revealed significant differences in rates of interaction (U = 5.00, P = 0.02) between blue, green, yellow, and red toys. Results from control toy combinations showed an equal number of interactions between the same colored toys (see Fig. 1). When paired with the same color, no one toy had significantly more interactions than the other. Every toy had an average of six interactions per hour throughout the testing period. In contrast, a significant difference was seen in experimental toy combinations (see Fig. 2). Blue toys had a total of 147 male and 151 female interactions, in comparison to green and yellow toys that averaged about 24 interactions for both genders. As for red, males interacted 120 times and females 126 times. Although lower than blue, red toys were selected more than green and yellow.

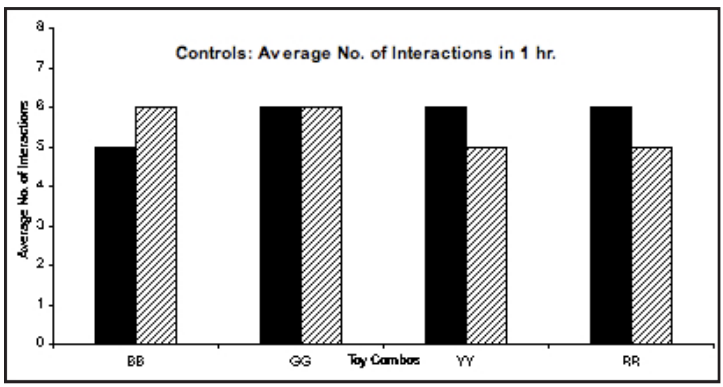

Figure 1: Average number (No.) of interactions in control groups BB, GG, YY, and RR during the one hour sessions across the three week testing period. All control groups resulted with dogs interacting within close range for each toy.

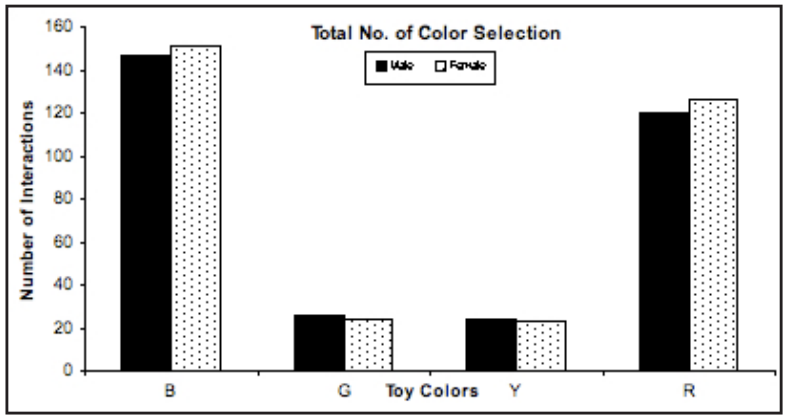

Figure 2: The total number of interactions with each color toy over the three-week test period. The 10 male (black) and 10 female (white) subjects showed greatest interest in blue (B) toys, followed by red (R) toys. Fewer interactions occurred with green (G) and yellow (Y) toys.

One-tailed Wilcoxon matched-pairs signed-rank test (T = 2.03, P = 0.02) showed a significant difference with all experimental toy combinations. Blue toys, resulting with the highest number of interactions, were compared with the other three colors (see Fig. 2). Toy combinations blue/green, blue/yellow, and blue/red showed higher number of blue interactions in each combination (see Fig. 3A). Blue had between

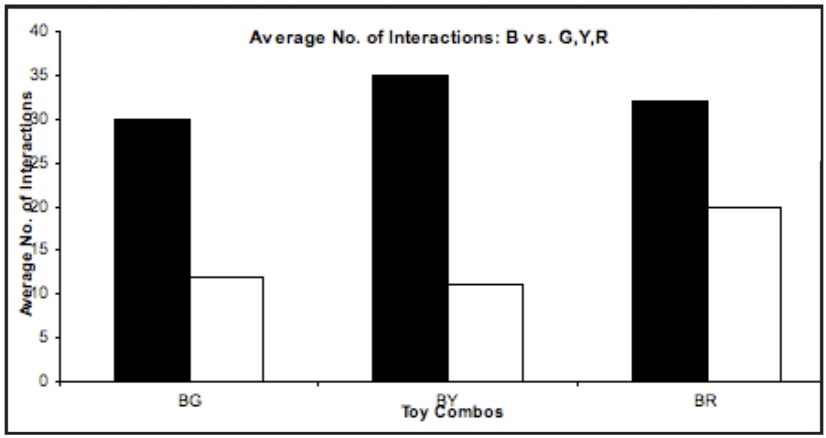

Figure 3A: Comparison of color selection per week when B is coupled with G, Y, or R toys. In these experimental combinations, B toys resulted in increased interaction when subjects were presented B and another color.

30 to 35 interactions in comparison to the following: red with 20, green with 12, and yellow with 11. When given the choice between red and another color, dogs chose red toys an average of 26 times, compared to an average of 11 times for yellow and for green (see Figure 3B). A similar number of interactions occurred between green and yellow toys, averaging 10 interactions (see Fig. 3C).

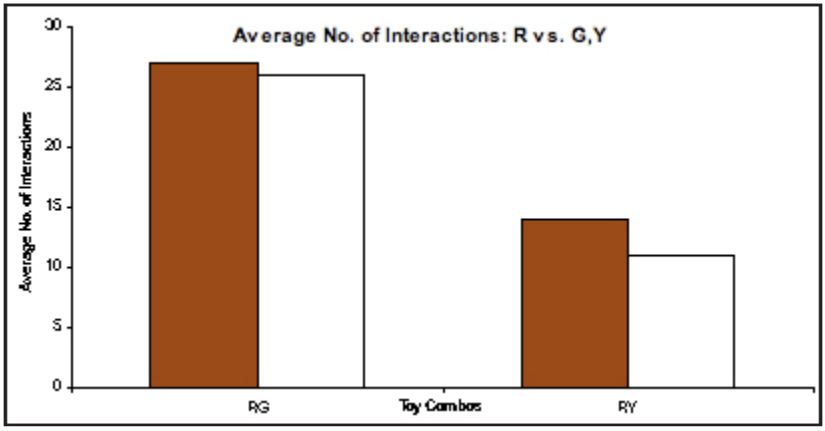

Figure 3B: Comparison of R versus G and Y toys. Average number of interactions increased for R when subjects were presented with R and another color.

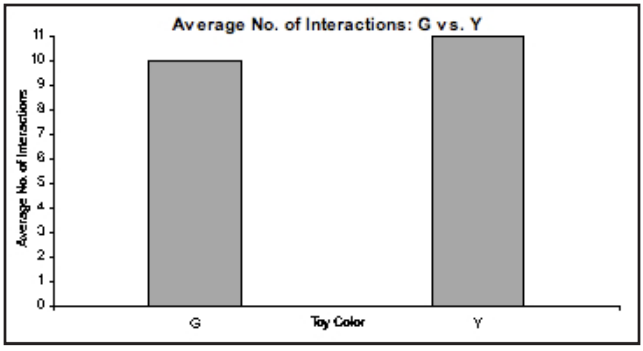

Figure 3C: Comparison of G versus Y toys. When given G and Y toy combinations, subjects selected both colors equally with no significant difference in numbers of interactions.

3.2 Length of interactions: Subjects spent an average of 47% of their time interacting with blue toys during one-hour sessions. The other colored toys had the following results: 17% red, 10% green, and 8% yel-

low (see Fig. 4). Subjects played with blue toys about 28 minutes each day compared to 5 to 10 minutes for the green and yellow toys. The time for red toys was higher—17 minutes—but remained significantly lower than for blue toys. Blue toys resulted in longer play times that steadily grew as each day progressed. Red toys, with less play time than blue, also steadily increased in interaction. Green and yellow toys both had similar intervals of play that continuously declined. Although blue and red toys

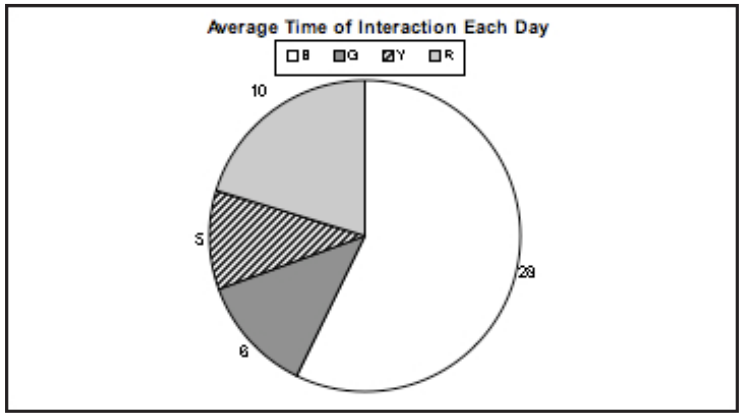

Figure 4: Graphical representation of the average time (min.) spent during daily interactions with toy combinations. Results show subjects spending the majority of their time interacting with B toys, followed by R and then G and Y.

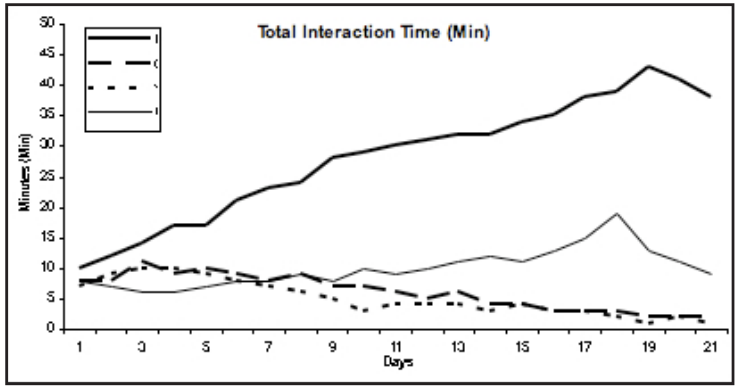

Figure 5: Average time of interaction with each colored toy over the three-week test period. Graph shows daily averages of toy interaction from all subjects. B (thick line) and R (thin line) resulted in steady increase in play that later decreased. G (large dashed line) and Y (small dashed line)continually declined in intervals of play as each day progressed.

had longer play intervals, the interaction rates decreased near the end of the study.

4. Discussion

4.1 Color discrimination and preference: In this study, results showed blue and red toys were selected more frequently, which confirmed studies of canine retinal peak sensitivity by Neitz et al. (1989) and Jacob et al. (1993). Being more sensitive to blue and red wavelengths, subjects did prefer blue and red over green and yellow toys (see Fig. 3). Blue toys were selected more than any other color. If there was a choice between a blue toy and another color, the majority of the dogs chose to interact with the blue toy. In contrast, when a blue toy was not present, dogs chose red over green and yellow. Interestingly, when given the option between green and yellow toys, subjects had no preference for one over the other; dogs were unable to discriminate between green and yellow because their eyes lack sensitivity to their wavelengths.

4.2 Colors effect on length of interaction: Not only do blue toys get selected more, the color also leads to long-term interactions. Within the hour, dogs spent a considerable amount of time interested in blue and red toys, particularly blue toys (see Figs. 4 and 5). Hence, preference for blue toys results in extended interaction with toy enrichment. Owners must consider, however, the possibility of dogs losing interest to any toy over a long period of time. Knowing that dogs prefer blue and red toys, researchers can, in future studies, use these colors as control variables and focus on other aspects of enrichment toys, such as shape, texture, and smell. Studies can also investigate whether rotation of blue and red toys extends a dog's interaction with enrichment items other than chew-toys. And studies could compare behavioral differences between male and female dogs and publish play ethograms associated with different colors. Overall, the knowledge that dogs do have a higher preference for blue colored toys enables adoption shelters, dog trainers, and dog owners to enrich the lives of their dogs through use of blue colored toys—the canines' eye-catching color.

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