TRAINING PENGUINS TO INTERACT WITH ENRICHMENT ITEMS FOR LASTING EFFECTS

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Over the past several decades, zoo have begun to focus more on the use of enrichment to promote the "well-being" of their animals, (Markowitz & Aday, 1998). One purpose of enrichment is to promote more naturalistic behaviors on the part of captive animals. Much of how this is accomplished is with food items or toys that elicit natural foraging responses in the animals. Some examples include the use of particular food presentations in various bears (Carlstead, Seidensticker, & Baldwin, 1991; Forthman, Elder, Bakeman, Kurkowski, Noble, & Winslow, 1992; Law, Boyle, Johnston, & MacDonald, 1990), and in captive felids (Lyons, Young, & Deag, 1997; Shepherdson, Carlstead, Mellen, & Seidensticker, 1993), acoustic "prey" with captive African leopards (Markowitz, Aday, & Gavazzi, 1995), and the use of inedible, manipulable objects with several species of bears (Altman, 1999).

The past few decades have also seen a dramatic increase in the application of behavioral training techniques (largely operant conditioning procedures) with zoo animals. Much of the use of these techniques have been for husbandry purposes. These techniques have also been used to decrease aberrant behaviors such as aggression and stereotypies, increase species-specific behaviors, and a general promotion of the welfare of the captive animals (Desmond & Laule, 1994; Forthman & Ogden, 1992; Markowitz, 1978). Some examples include decreasing aggression in a male chimp during feeding times (Bloomsmith, Laule, Alford, & Thurston, 1994), training a diabetic chimp to allow staff to reliably obtain blood and urine samples (Laule, Thurston, Alford, & Bloomsmith, 1996), and using various conditioning procedures to train bongo and nyala to enter a crate for husbandry purposes, (Grandin et al., 1995; Phillips, Grandin, Graffam, Irlbeck, & Cambre, 1998).

While training has been talked about as an effective enrichment strategy (Laule & Desmond, 1998), little has been to combine the two approaches. Animals are generally viewed as either interacting with an enrichment item or not doing so. Training might provide temporary changes, but how would this last beyond the contrived training sessions? In essence, how could you combine training with enrichment to produce lasting effects?

The following study attempted to examine what occurs when training and enrichment are combined. Three hypotheses were tested: (1) Can we effectively train penguins to interact with specific enrichment items? (2) What happens when we remove the training procedure? And (3) can we manipulate the items in such a way that the combination of both training and the enrichment items produces effects that last beyond either manipulating the items or training alone?

Methods

Subjects:

We initially chose 2 penguins from 3 species (king, magellanic, and rockhopper) for a total of 6 penguins. However, the kings were dropped, due to breeding/nesting activity. The subjects, therefore, were 4 penguins: Buddy, Maggie (both magellanic), Squirt, and Hemingway (both rockhoppers). In the latter part of the study, 5 more rockhoppers were tested for total enrichment item interactions.

Penguins:

rockhopper

magellanic

Materials:

Enrichment items: Two different colored hamster balls (1 red, 1 blue) that could be manipulated to allow smelt to hang out of them. Smelt (a small fish) were used during some conditions inside the balls, and Palm Pilots were used to collect data.

Procedure:

Extensive baseline measures were used to ensure penguins engaged in little to no interaction with the items previous to any condition. 3 observational periods were measured throughout the study: 20 minutes before, during, and after introduction of hamster balls (1-hour session). During the experimental conditions, balls were manipulated with several conditions of training and smelt in the balls for one or both balls (see table below for a description of each condition and presentation order). 2 measures taken: Swimming activity, and continuous ball hits on either ball. Sessions were taken 1-2 times a day, and only on weekends. A multiple-baseline design across balls with several reversals was used.

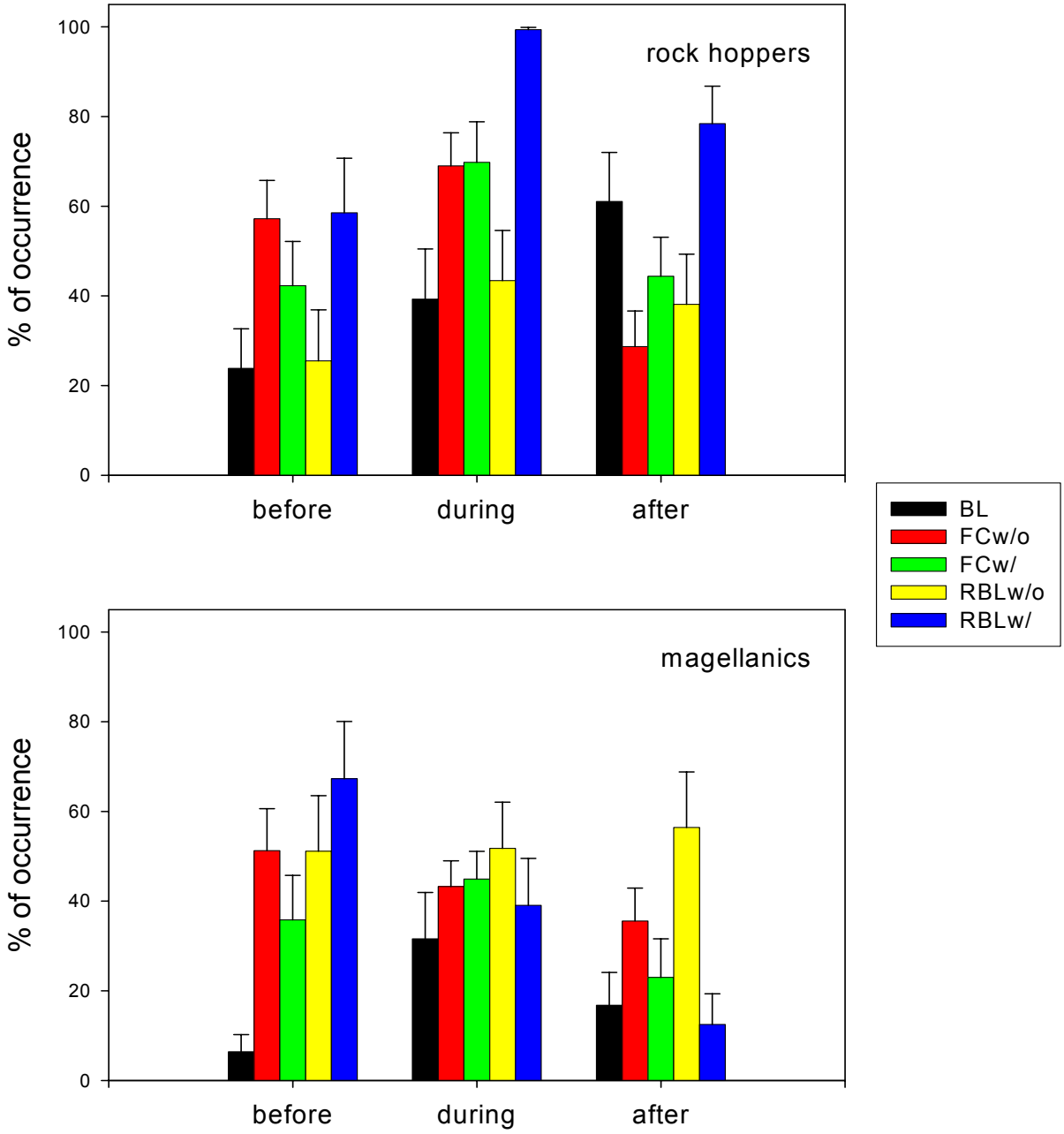
Conditions:

CONDITION	DESCRIPTION	SUB-CONDITION	SESSION
BASELINE	Balls initially tested to determine ball interactions w/ and w/o food, and total swimming times.	both balls have fish	1-2
		only blue ball has fish	3-5
		neither balls have fish	6-7
FOOD CONT. W/O	Training to both balls, but without food in either ball. Training is tested across each ball for any ball bias.	train to red ball only	8-10
		train to both balls	11-13
		train to blue ball only	14-16
FOOD CONT. W/	Training to both balls, but with food in both balls. Training is tested across each ball for any ball bias.	train to red ball only	17-19
		train to both balls	20-22
		train to blue ball only	23-25
RBL W/O	Return to baseline w/o food in either ball.	no food in either ball	26-31
RBL W/	Return to baseline w/ food in both balls.	food in both balls	32-37

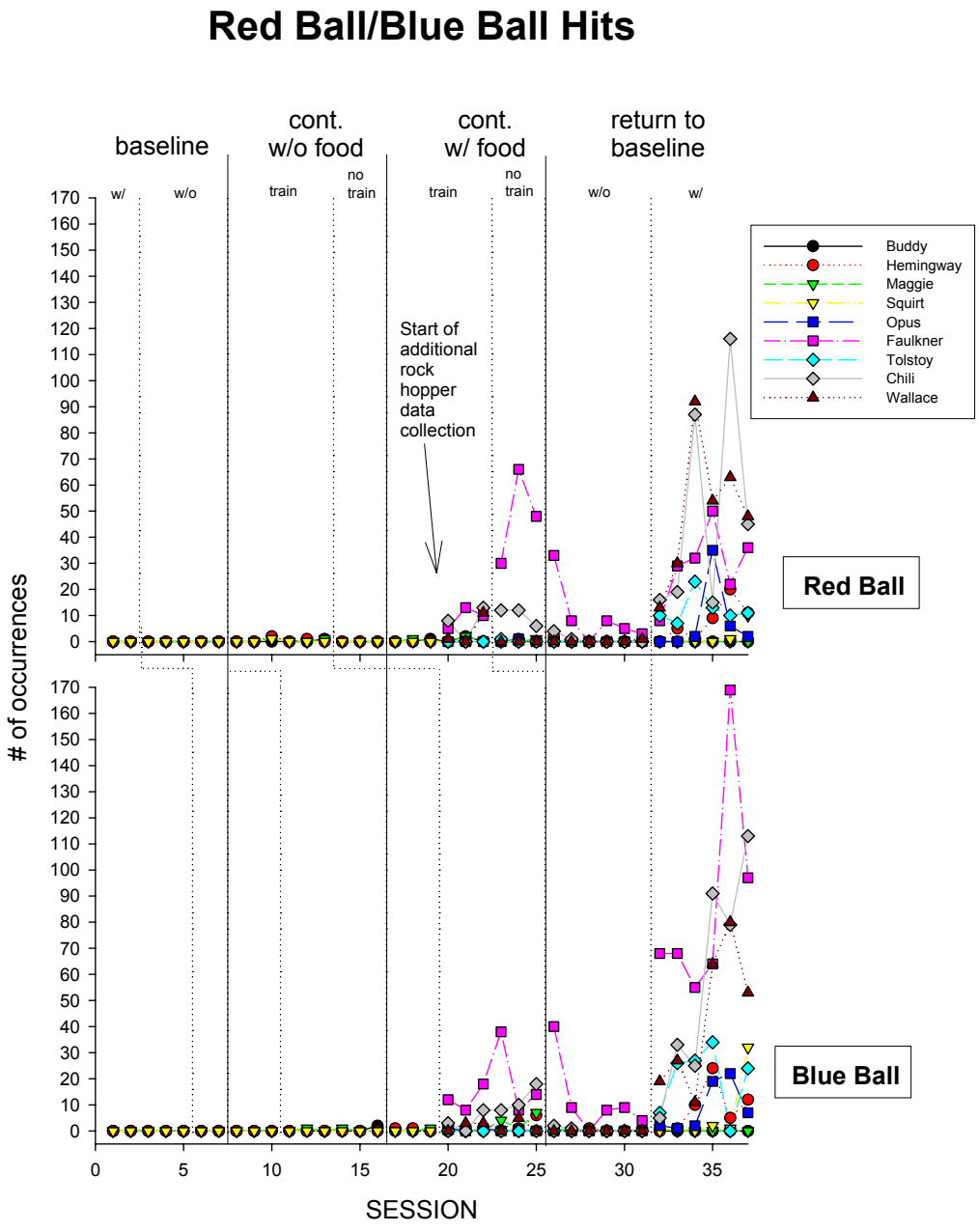
Results

The following graph is of total swimming times for the two rockhoppers combined, and the two magellanics combined. The y-axis is the % of time spent swimming, and the x-axis is the 3 20-min periods of time (before, during, and after a ball is introduced). As can be seen in the graph, you don't get much of an effect with the magellanics (i.e., Buddy and Maggie), and that's also seen in the next graph (where they rarely hit the enrichment balls). The rockhoppers, however, show a significant increase in swimming time, especially in the last condition (which is the 'lasting effect' condition). Why this discrepancy between penguin species occurred is not known, but some possibilities are mentioned in the discussion.

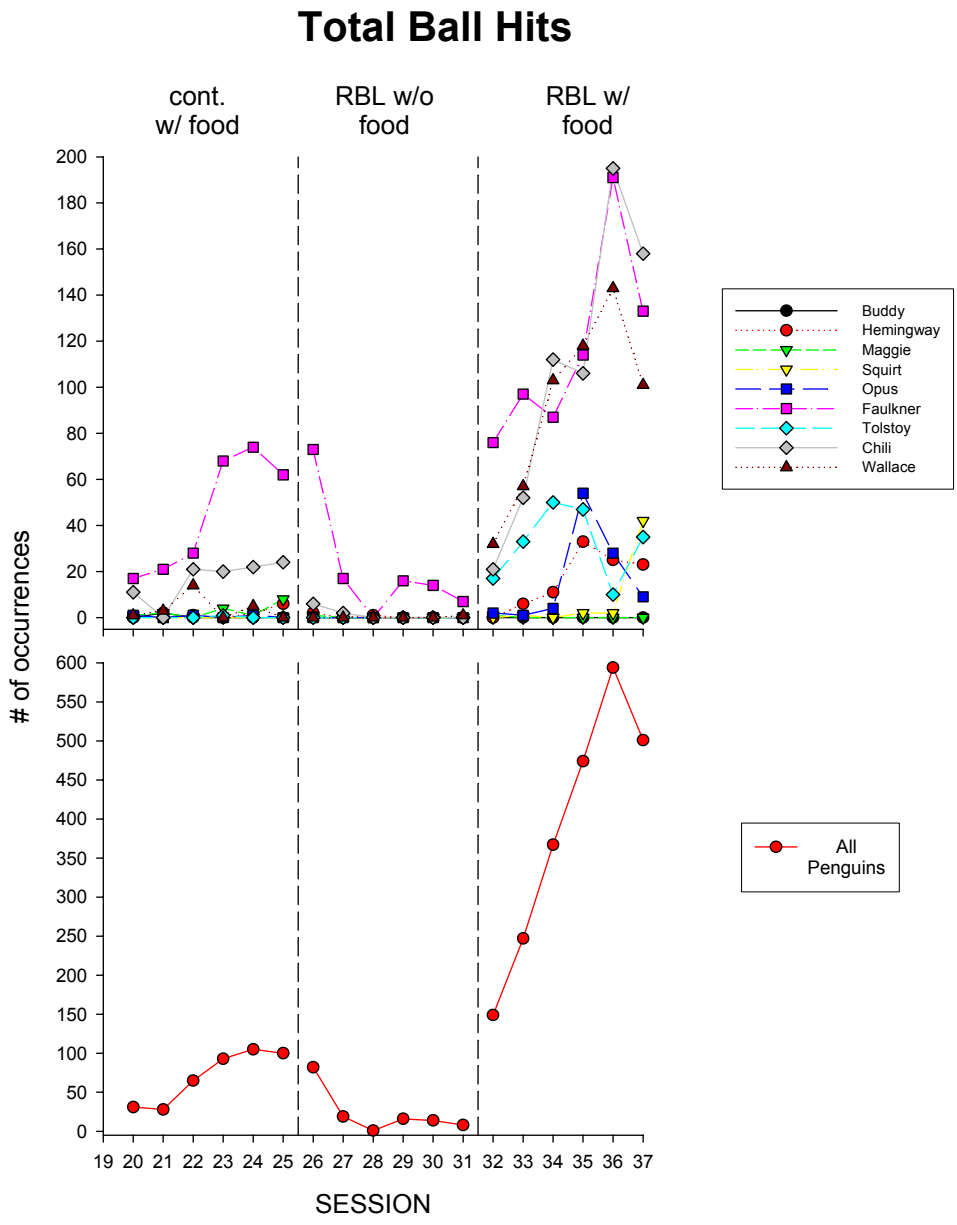
TOTAL SWIMMING TIME



The following graph shows ball hits on each colored ball during all the conditions of the study. The y-axis shows the total # of ball hits, and the x-axis shows each session. Following session 19, the 5 other rockhoppers in the enclosure were also measured for total ball hits, since they began to hit the balls during the cont. w/ food condition. While these 5 other rockhoppers were not measured for swimming time ever, and were not measured for hits on the ball previous to session 20, we did observe that no hits occurred for any penguin during the baseline condition, and no more than 1 or 2 hits occurred for any penguin during the cont. w/o food condition. Note that when Faulkner is hitting the red ball at a much higher rate in the cont. w/ food condition is when food is only being thrown to the blue ball (this is similar to the increased swimming/increased ball hitting effect seen in the return to baseline condition). Buddy (black circle) and Maggie (green triangle) are the two magellanic penguins. They show very little hitting on the balls, as mentioned in the previous graph's comment.



The following graph represents the total ball hits, regardless of ball color, for sessions 20 – 37, when all rockhoppers were measured for ball hits. The top graph represents each penguin's hits on either ball, and the bottom graph represents the total number of hits across all penguins. The y- and x-axis are the same as the previous graph. As can be seen, the penguins begin to hit the balls more during the initial training condition with food in the balls (cont. w/ food condition). This effect extinguishes, however, once training is removed, and no food is in the ball. However, when the ball is re-introduced with food and without training, we get a significant increase in hitting the balls compared to all previous conditions (including when this condition was previously run prior to training). This, in essence, is the lasting effect (since training is no longer in effect), and required the previous training condition to occur.



Discussion

In both the pre-ball and ball conditions, all penguins swam more during training conditions. All penguins showed little to no interactions with balls when under training (FC w/o) alone condition. During the training w/ food in balls (FC w/) condition, the rockhoppers showed an increase in interactions with the enrichment items.

When baseline was returned to without food (RBL w/o), these ball hits went down (extinction, as expected). Swimming increased for magellanics at this time, but returned to baseline levels for rockhoppers. Why the swimming increased for the magellanics is not known. In fact, the data for the magellanics are generally inconclusive along all of our hypotheses. However, for the rockhoppers, following training, the w/ food (RBL w/) condition showed both dramatic increases in swimming times and ball hits for rockhoppers. In essence, training combined with enrichment led to a lasting enrichment effect that was not seen prior to training.

Why these effects were not seen in the magellanic penguins is not known. Several possibilities include significant species differences in how they forage, and hence, differences in how the enrichment items support species-typical foraging patterns, differences in how the experimenters' presence affected the different species of penguins, and/or differences due to consequences that occurred for both penguins' swimming activity. Further testing with the magellanics could help determine why this did or did not occur.

Future Directions:

We plan to do a 1-year follow-up to test for continued lasting enrichment effects. Anecdotally, the enrichment items are still used for public demonstrations, have not received further training, and still produce significant interactions. Other future directions could include testing the magellanics apart from the rockhoppers, and the use of live-food dispensers or more naturalistic enrichment items. Finally, tests of similar training/enrichment combinations could occur with other species of penguins, birds, and zoo animals in general. Currently, we're testing the effects of a live-feeding enrichment device with an outdoor little blue penguin exhibit. By using similar methods across a variety of animals, we can better achieve successful enrichment, and thus, better welfare of the animals we house in captivity.

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