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# ENRICHMENT PREFERENCES OF RAPTORS AT ELMWOOD PARK ZOO

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**A B S T R A C T**

Environmental enrichment is often offered to animals in captivity to aid in enhancing quality of life by providing appropriate environmental stimuli that improve psychological and physiological well-being. Due to the limited amount of research conducted on raptors and enrichment, I sought to determine raptor preferences of enrichment types through the observation of captive bald eagles (*Haliaeetus leucocephalus)* and red-tailed hawks (*Buteo jamaicensis*) in the education department at Elmwood Park Zoo. I predicted that the raptors would interact more with natural enrichment items compared to ones that were man-made. Although results showed only the female bald eagle to interact enough with the enrichment items to gather an adequate number of observations, she was found to interact significantly more frequently with natural enrichment items compared to ones that were man-made ($p < 0.0001$, FET). These results are not meant to infer that all female bald eagles prefer natural enrichment items over man-made ones, or that all male bald eagles and female and male red-tailed hawks do not prefer any enrichment items. Nonetheless, they justify future research on environmental enrichment preferences involving many more individuals and many more taxa to determine more appropriate enrichment regimens for captive birds of prey.

**Keywords**: birds of prey; zoo; enrichment; preferences; behavior.

## INTRODUCTION

Captive animals rely on their caretakers for the provision of food, water, and shelter, all of which are necessary for survival. Caretakers are also responsible for providing a nurturing and enhanced environment (Mehrkam and Dorey, 2015) ensuring that the animals in their care receive appropriate environmental enrichment along with other necessities of a comfortable and stimulated life. Environmental enrichment refers to the enhancement of the quality of life of captive animals through appropriate environmental stimuli that are needed to maintain and/or increase psychological and physiological well-being (Swaisgood and Shepherdson, 2005). Yerkes (1925) and Hediger (1950), both recognized the value of enrichment, finding that management tactics and diet could have a significant impact on the well-being of captive animals. This is indicative that improved physical and social aspects of an animal's environment are of great importance.

Essential factors to consider before providing enrichment are to examine the species' natural history, the animal's individual history (including medical and behavioral), and the specific limitations of the exhibit in which they thrive in order to determine what provisions are most appropriate (Millen and MacPhee, 2001). Mimicking an animal's natural habitat is not always appropriate for improving the well-being of captive animals because they may either be unfamiliar with conditions in the wild and/or they may be incapable of thriving in an environment based on conditions in the wild due to potential stress or injury (Shepherdson, 1998). Instead, each animal's captive environment should be assessed by suitable criteria. The environment created should increase the opportunity to express species-appropriate behaviors, while simultaneously decreasing the chances of displaying stereotypic behaviors, such as pacing or plucking, that may signal an animal's stress level (Millen and MacPhee, 2001).

Creating stimulating and complex environments can be accomplished in various ways. Some methods include substrate changes such as switching dirt for leaf litter or using varying vegetation. Adding structures to

enclosures and changing landscaping within enclosures can increase investigatory behavior, create privacy, or elicit territorial behavior (Swaisgood and Shepherdson, 2005). More complex materials such as puzzle feeders and computer games can help with psychological growth. Along with altering the physical aspects of the enclosures, other forms of enrichment can be added to the animals' environments, including things such as toys and novel objects that can create active experiences which can promote exploratory behavior.

In an analysis of 30 publications that focused on the provision of enrichment and its effects on animal welfare and behavior, only one article focused on birds (Swaisgood and Shepherdson, 2005). Further, the limited research conducted on captive birds and enrichment was not conducted in zoos (Rodriguez-Lopez, 2016). This study responds to the lack of research on animal enrichment and zoo raptors by investigating the appropriate enrichment for increasing the exploratory and creative behaviors of birds of prey in zoos. Previous research suggests that animals prefer certain enrichment types over others and that animal welfare can be improved through enrichment (Mehrkam and Dorey, 2015). Previous studies have also shown some bird species that interact with natural enrichment items including hay and sticks (Ohara et al., 2015). In accordance with the literature, the hypothesis anticipated was that the bald eagles and red-tailed hawks housed at Elmwood Park Zoo's education department would prefer the natural enrichment items over those that are man-made.

**MATERIALS AND METHODS**

**Subjects and Setting:** Two adult bald eagles (*Haliaeetus leucocephalus)* of both sexes, and two adult red-tailed hawks (*Buteo jamaicensis*) of both sexes, were observed during the course of this study at Elmwood Park Zoo in Norristown, Pennsylvania. The eagles and hawks met the minimum of four subjects for conducting observational studies on enrichment preferences (Swaisgood and Shepherdson, 2005). All raptors observed sustained injuries impacting their ability to fly or see, which is why they are under the care of the zoo's education department, and as such, are not on exhibit.

The two bald eagles are housed together in a flight enclosure that is 9.75m long by 4.19m wide by 3.25m high (Figure 1). The two red-tailed hawks are also housed together in a flight enclosure that is 4.88m long by 3.05m wide by 2.39m high (Figure 2). The bottoms of the enclosures are covered in stone, and the sides and roofing are composed of vinyl-coated wire fence. The staple contents of the bald eagle enclosure include perching, stumps, logs, two small pools, a water dish, a corner perch with a roof, and a large platform nest box. The staple contents of the red-tailed hawk enclosure include perching, stumps, logs, a water dish, and a corner nest box.

Figure 1. Bald eagle enclosure. The male bald eagle is to the top left, perched in the corner. The female bald eagle is also to the left, on the ground near a stump. Location of bald eagles are marked by circles.

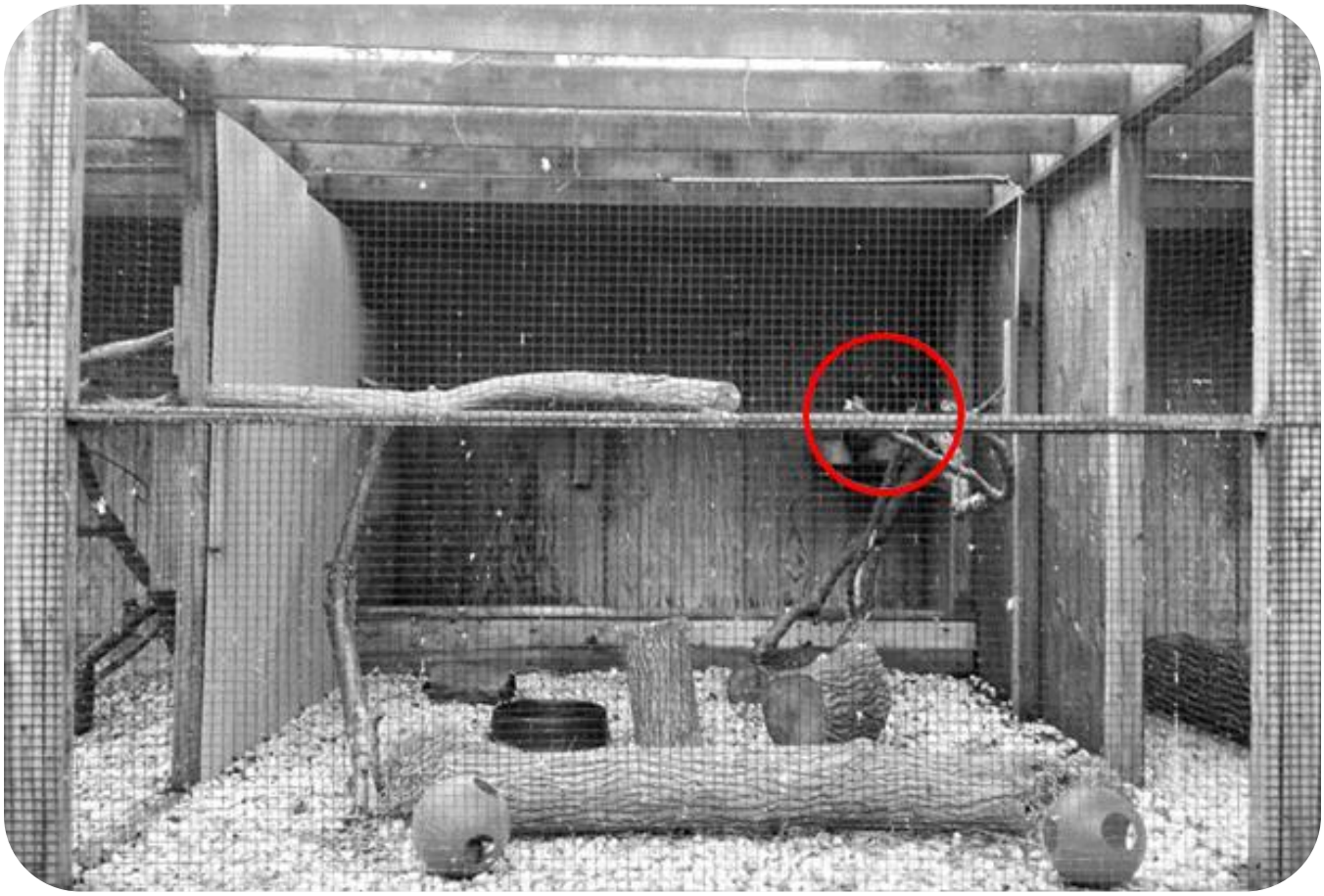

Figure 2. Red-tailed hawk enclosure. Both red-tailed hawks are to the top right, perched on their nesting box. Location of red-tailed hawks is marked by a circle.

**Materials and Design:** Enrichment materials offered included straw, hay, sticks of white pine (*Pinus strobus*) Jolly Balls (large, hard plastic balls with holes, holding a smaller soft plastic ball inside), hard plastic half-balls, and soft plastic balls (Figure 3). Hay, sticks, and white pine were considered "natural" enrichment items because they were derived from plants and can be found in nature. In contrast, the balls were considered "man-made" enrichment items because they were created through chemical processes and cannot be found in nature. Natural and man-made enrichment types were provided in combination (hay and Jolly Balls, hay and hard plastic half-balls, hay and soft plastic balls, etc.) allowing for paired-stimulus preference assessments to be conducted. Pairing stimuli aids in counterbalancing enrichment types across trials, creating a more controlled experiment while also diminishing bias (Mehrkam and Dorey, 2015). Each pairing of man-made and natural enrichment types was randomized using a random number generator in Microsoft Excel to amend the potential bias caused by possible preferences for one enrichment item over the other. Observations were recorded with a Bushnell Trophy Trail Camera HD and a Canon EOS Rebel t5 EF-S SLR Camera 18-55 mm.

Each time a raptor touched an enrichment item with any body part for a minimum of three seconds or manipulated the enrichment type in some way (e.g., picked it up with the beak or feet or moved it to a location separate from where it was originally placed) it was counted as an interaction (Mehrkam and Dorey, 2015). Interactions were categorized as follows: 1) raptor did not touch the enrichment item with any part of its body; 2) raptor barely touched the enrichment item ("barely" was defined as the raptor touching the enrichment item anywhere from one to three seconds); 3) raptor touched the enrichment item (for more than three seconds); 4) the enrichment item was moved by the raptor; and 5) the enrichment item was destroyed by

the raptor ("destroyed" was defined as the enrichment item being damaged enough so that it was clearly in a different state from which it originated; e.g. the straw was torn apart so that it was no longer in a flake and was scattered about the enclosure) (Millen and MacPhee, 2001; Powell, 2008). If a raptor moved past an enrichment item and accidentally touched it, it was not recorded as an interaction.

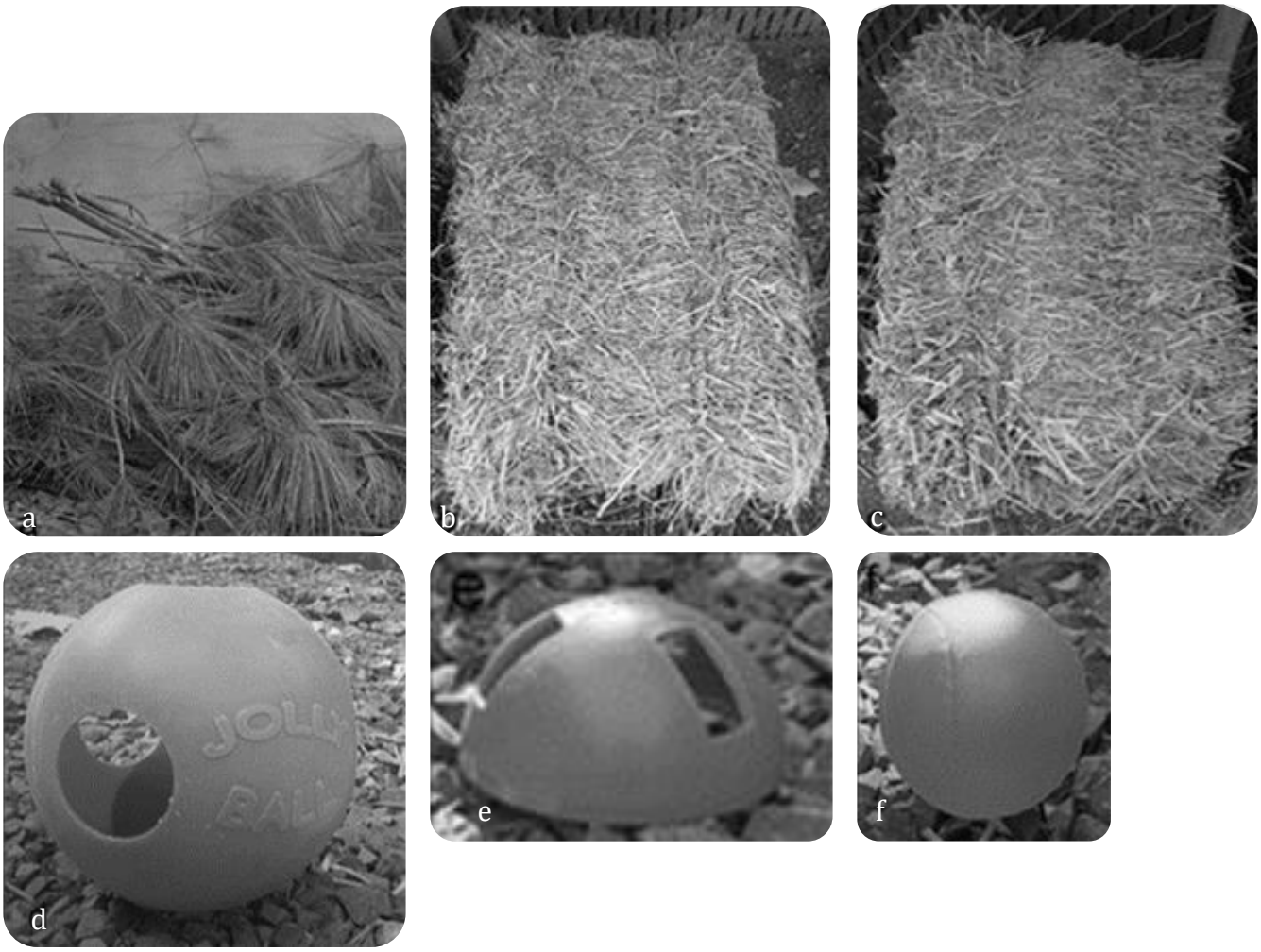


Figure 3. Enrichment types provided to bald eagle and red-tailed hawks; (a) sticks of white pine; (b) bale of hay; (c) bale of straw; (d) Jolly Ball; (e) hard plastic half-ball; and (f) soft plastic ball.

All raptors had previous opportunities to interact with each of the aforementioned enrichment items, therefore no item was novel. This was done to eliminate possible bias due to the introduction of a new item, as well as the potential harm or distress a new item could cause to the birds. These raptors have never displayed any signs of discomfort in the past with any of the listed enrichment items.

**Procedure:** In compliance with the Institutional Animal Care and Use Committee (IACUC), I obtained approvals for research on birds of prey from both Miami University and Elmwood Park Zoo in October 2016. I collected data from October 6th to October 21st. Over a total of nine days, I made observations on every combination of natural and man-made enrichment types. Data were not consecutively collected due to inclement weather. Prior to data collection, I placed the camera equipment outside of the raptors' enclosures so that they could acclimate to the equipment's presence. All data were compiled ethogram tallies. I observed initial interactions with the enrichment items without using camera equipment for a total of 20 minutes between 7:00 AM. and 7:45 AM. A Canon camera and Bushnell trail camera recorded

observations for thirty-minute periods in the morning between 7:30 AM. and 8:30 AM, and in the afternoon between 3:00 PM. and 4:30 PM. One camera filmed the eagles while the other was set up on the hawks; they were switched between morning and afternoon sessions and each day. Weather conditions were also recorded (e.g. temperature, wind, clarity, etc.). Rain and heavy winds prevented data from being collected on some days. Data collection did not coincide with the raptors' normal schedule of being fed or cleaned.

I placed two sets of enrichment types (both natural and man-made) in the enclosures of the hawks and eagles around 7:00 AM. each day. Two sets of natural and man-made enrichment types were placed in each enclosure, generally in the same locations for each observational session. All enrichment was placed on the ground of the enclosures and not on any stumps, perching, shelving, or houses. Initial interactions were then recorded via personal observations. After initial observations were completed, camera equipment was placed in appropriate positions so that one camera recorded interactions made by the bald eagles, and the other recorded interactions made by the red-tailed hawks. After afternoon observations were completed, all enrichment was removed from the enclosures to prepare for the next day of observations.

**Data Analysis:** To determine if raptors interacted more often with man-made enrichment types or natural enrichment types, Fisher's exact tests were performed on the observations of the male red-tailed hawk and female bald eagle (GraphPad QuickCalcs: Fisher's Calculator, 2015). Individual tests were not conducted on the male bald eagle or the female red-tailed hawk.

**RESULTS**

The frequency of interactions made by each raptor with man-made and natural enrichment types was recorded. None of the raptors were observed interacting with man-made enrichment items. Out of a total of 685 recorded observations, the male red-tailed hawk was observed interacting with one natural enrichment item (white pine) for one count. Out of a total of 685 recorded observations, the female bald eagle was observed interacting with two natural enrichment items (straw and hay) for 22 counts.

The frequency of the male red-tailed hawk's interactions with natural compared to man-made enrichment items was not significantly different ($p$ = 1.0000; FET). The female bald eagle was observed touching and moving flakes of straw with her talons, and touching, moving, and destroying flakes of hay with her beak and talons. She interacted more often with the hay than with the straw (Figure 4). Analyses show that she interacted significantly more frequently with natural enrichment items compared to man-made ones ($p$ < 0.0001, FET).

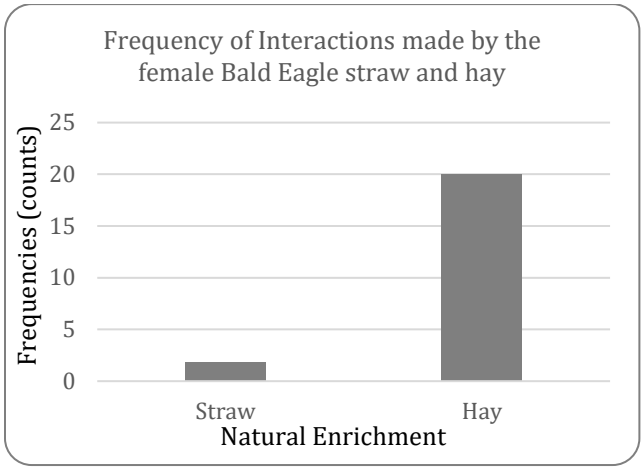


Figure 4. Frequencies of observed interactions with straw and hay by the female bald eagle. She was observed interacting with straw for two counts and with hay for 20 counts.

**DISCUSSION**

Study results do not support the hypothesis that both Elmwood Park Zoo's education bald eagles and red-tailed hawks interact more frequently with natural enrichment types (piles of sticks of white pine (*Pinus strobus*), flakes of hay, and flakes of straw) than with man-made enrichment types (Jolly Balls, hard plastic half-balls, and soft plastic balls), largely due to the fact that only 50% of subjects participated in the study. Of the two raptors that interacted with the enrichment material offered, the male-red tailed hawk could not be determined to prefer one enrichment type over the other because of so few observations. However, the female bald eagle was found to prefer natural over man-made enrichment items.

Environmental enrichment has not only shown to increase animal welfare through the inclusion of proper stimulation, but it has also shown to decrease the detrimental effects of captivity as well. Appropriate enrichment is capable of decreasing harmful stressors that could act on hormones, the brain, and overall anxiety in adult animals (Ashokan et al., 2016). Since

Elmwood Park Zoo's education raptors cannot be reintroduced into the wild either due to imprint or injury, adjusting to a new environment could potentially be a stressful event. For these birds, providing an environment that can maintain low stress levels and equally as importantly, encourage investigative behaviors, is therefore essential. The challenge however, is to determine the appropriate enrichment.

A study involving broiler chickens at a commercial farm in Japan found that these birds often interacted with hay bales and perches, with the females interacting more with these natural enrichment items compared to the males (O'hara et al., 2015). This enrichment material allowed the broilers to demonstrate natural behaviors, reduce stress levels, and decrease footpad dermatitis. O'hara et al.'s (2015) study suggested that female birds might partake in more investigative behaviors than males, which is similar to what was observed in this study with the female bald eagle. The male broilers were often observed feeding, drinking, and resting whereas the females were often observed foraging, preening, standing, walking, and perching. They suggest that foraging is a more relaxed behavior than feeding or drinking. Because the male broilers appeared to be more invested in feeding behavior, investigating and interacting with straw and hay might be suppressed in males (Ohara et al., 2015). This may be why the male bald eagle in this study was less inclined to interact with enrichment items because foraging or investigatory behavior was suppressed and/or not a priority.

Although the male red-tailed hawk did not appear to prefer one enrichment type over another as he interacted only once with a single natural enrichment item, that enrichment material was a pile of sticks of white pine. In the wild, dry sticks and twigs are the primary materials used by hawks for creating nests (Figueroa and Ricardo, 2007; Sullivan et al., 2011). Many hawk species, such as Cooper's hawks (*Accipiter cooperii*), use tree species such as Aleppo pine (*Pinus halepensis*) to create nests (Boal, 1998). Because of the availability of white pine, and the preference of hawk species to use pine for creating nests, it was reasonable to provide such nesting material for the red-tailed hawks, particularly since creating a nest together is a natural behavior for a mating pair. It is possible, however, that the timing of this project could have influenced the level of interaction. Nesting season for red-tailed hawks usually lasts from February through April (Sullivan et al., 2011), and it is therefore possible that the hawks might not have had a functional reason to interact with the sticks during the time of data collection.

Behavioral observation is one of the most common methods used to evaluate the effectiveness of enrichment in zoos (Mehrkam and Dorey, 2015). However, it is difficult to collect enough quantitative data due to the time-intensive nature of this method, which was found to be true for this study. Reporting visual observations was feasible for no longer than 20 minutes during work days and reporting recorded observations could not exceed 30 minutes at a time because the camera needed to be reset after a maximum of 30 minutes. Therefore, only 80 minutes of observations were recorded daily. Longer monitoring periods could determine more accurate levels of interactions throughout the day and/or night. For instance, every day before the afternoon recording session began, at least one pile of natural enrichment in the eagles' enclosure was moved or destroyed. It is speculative, of course, to assume a purposeful interaction occurred when it could have been elements such as the wind that moved the enrichment material. It is possible that the raptors could have fallen on the enrichment since both bald eagles are injured, with the male bald eagle possessing only one functioning eye and the female bald eagle possessing only one functioning wing. I have observed the female bald eagle attempting to jump from one perch to another, only to roll on the ground instead. It is possible that she could have collided with the enrichment giving the appearance that the enrichment was moved or destroyed. However, it is also likely that unrecorded interactions occurred. An additional factor worth analyzing would be the time spent with each enrichment type, in order to compare the duration of each occurrence, as opposed to the frequency of the interactions with different enrichment types.

It would be worthwhile to determine duration and frequency of varying forms of enrichment provided to raptors to determine preference. There are many other forms of enrichment that are available for the animals at Elmwood Park Zoo. These include materials such as PVC pipe, puzzle feeders, mirrors, wind chimes, boxes, pumpkins, old Christmas trees, etc. There are also other forms of enrichment outside these ludic groups of toys and tactile enrichment that

are provided to the animals in the education collection, including auditory/visual, dietary, and scent enrichment items. The spectrum of enrichment that is accessible to birds is extensive. It should not be assumed that hawks and eagles are only capable of being stimulated by a few tactile enrichment items.

The placement of enrichment items might have also influenced study results. Enrichment items were invariably placed on the ground in areas that were easily viewable for recording observations. It remains possible that the raptors did not prefer these specific areas of their enclosures. If enrichment were placed on perching or stumps where raptors appear to spend more of their time, they may have interacted more with the enrichment.

Despite some limiting factors, the study's results still suggest that enrichment provided a creative and explorative environment for at least one raptor that significantly preferred natural over man-made enrichment items. Enrichment can provide a beneficial environment to other raptors, as well as to other species of animals in captivity, albeit with different enrichment types, during different times of the day, throughout different times of the year, and in various locations within the animals' enclosures. For the female bald eagle, straw and hay successfully provided stimulation. The intention, therefore, is to continue to distribute such natural enrichment items to enhance her environment. Through the collaboration of the keeper department at Elmwood Park Zoo and continued observations of the education raptor collection, we hope to establish a more appropriate and specific enrichment schedule for these raptors in order to create a long-lasting, interactive, and stimulating environment.

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