Parenting Opportunity and Behavioral Wellness in a Rescued, Captive North American River Otter (*Lontra canadensis*)

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BACKGROUND

North American river otters (Lontra canadensis) belong to the subfamily Lutrinae, within the larger species Mustelidae. There are 13 different otter species that vary in size, habitat, diet, sociability, and foraging habits (DeLong, Wright, Fobe et al., 2018). River otters spend much of their lives solitary, but may at different times of their lives engage in more social behavior (e.g., caregiving, mating, cooperative foraging) (Kruuk, 2006). Home ranges for river otters can reach up to 250km, while marine foraging otters home ranges are closer to 20-40km.

Due to captivity, time spent foraging, hunting, and managing territories is now unnecessary for otters. An important part of captive care is provide biologically relevant behavioral opportunities to engage in such as foraging, hunting, or parenting. If enrichment in captivity fails to provide an outlet for biologically relevant behaviors, boredom can lead to non-purposeful, abnormal repetitive behaviors, or stereotypy.

Abnormal repetitive or stereotypic behaviors, refer to repetitive, invariant behavior, with no obvious goals or functions (Banshaw & Morabito, 2012). The more an animal engages in stereotypy, the more the behavior is likely a welfare issue (Shepherdson, 1989). Animals in captivity need to be able to explore, as well as maintain control, to satisfy their biological instincts (Goldblatt, 1993). Zoo's have come a long way in not only taking care of the animals physical needs, but also behavioral needs by creating an environment that is more enriching to species lifestyle.

While enrichment can provide opportunities for captive animals to exhibit species-typical behaviors, it could also be said that parenting/fostering can be just as motivating in providing biological opportunities (Smith, Win, & Island, 2018). Parenting has been overlooked in enrichment literature to date, mainly only with a focus on mental health of the offspring and early development, but no mention of how important parenting is. Parenting and or fostering can offer the animal a chance to engage in biologically relevant behaviors instead of stereotypy.

Empirical Questions

1. *Do the Oregon Zoo North American River Otters currently engage in ARB's?*
2. *For the matriarch, Tilly, does parenting context affect the presence and frequency of repetitive behavior?*
3. *If* **all otters engage in abnormal repetitive behavior, did Tilly engender her ARB's to the rescued juvenile otters (i.e., foster otters)?**

METHOD

Subjects

Tilly, (female, age 10, approximately 23 lbs; International Species Information System Number: AZA2358) named after the Tillamook River, is a 23 pound North American River Otter, found orphaned, malnourished, and wounded from an animal attack near Johnson Creek in 2009. Once her health improved, Tilly came to the Oregon Zoo in a transfer facilitated by the Oregon Department of Fish and Wildlife, which oversees the species' protection.

Flora, (female, age 5 months, weight unknown; International Species Information System Number: AZA2700), was rescued as an orphaned pup, found wandering a construction site near Gold Beach, Oregon. Since she was not able to be reunited with her mother, the Oregon Department of Fish and Wildlife found a permanent home for her at the Oregon Zoo (Oregon Zoo, 2019).

Hobson (Hobbs), (male, age 4 months, weight unknown; International Species Information System Number: AZA2701). was found in 2019 as an orphaned pup near a golf course in McMinnville, and was suffering from a respiratory infection. After a short stay at the Turtle Ridge Wildlife Center, officials found a home for him at the Oregon Zoo (Oregon Zoo, 2019).

Materials and Design

A total of 10 observers participated in collecting data for this project. Data collection began in March of 2016, and continued through March of 2020. Activity tracking consisted of 10-minute sections divided into 30-second intervals. Observers looked at the same otter during the 10-minute intervals in order to maintain inter-rater reliability. Observation times varied across Zoo exhibit hours between 9:30am-4:00pm, with an observation period of 90 minutes per session. Across 5 pairs of observers, (10 total) total interrater reliability value (Cohen's kappa) of K=.89 or 89% agreement.

Behavioral Ethogram

This ethogram was used to reflect species typical behavior among captive North American river otters (Smith, Win, & Island, 2018). The ethogram included one category of Welfare variables: Enrichment type and number, Visitor Density, Visitor Effect, Abnormal Repetitive Behavior, Displacement and three species-typical behavioral categories: Resting and Eating; Socializing and Play, Locomotion and Investigation (see Table 1). The ethogram's Welfare category included two visitor variables (Visitor Number and Visitor Effect Score) to identify cues in which visitors might contribute to dramatic changes in otter behavior, including displacement to more secluded areas of their enclosure. If visitors are loud, or invasive by clapping on the glass of the exhibit, or actively seeking out the attention of the exhibit animals, it could be very disruptive. The Visitor Effect Score (VES) assigns numbers to visitors in each observation session. The VES reflects a subjective scoring system along a 10-point scale, where 1 reflects calm visitor behavior and 10 represents loud, disruptive, behavior.

Exhibit Dimensions and Observation Zones

The length of the Oregon Zoo Cascade Stream and Pond exhibit is 1,330 square feet, with a pond taking up 40% of that area (Island, Win, Smith, Slyngstad, & Strack, 2018). All areas of the exhibit are visible from the visitor observation windows, and were assigned a Zone number 1 – 6; therefore all behaviors were recorded in the ethogram by zone to assess enclosure use and activity by zone.

RESULTS

The purpose of this descriptive, observational study was to assess the health and welfare of the captive, rescued, North American river otters at the Oregon Zoo. We wanted to see if abnormal repetitive behaviors decreased or increased in frequency during the foster parenting phase. The results are framed relative to each of the empirical questions outlined in the introduction.

1. *Do the Oregon Zoo North American River Otters currently engage in ARB's?*

✓ **Yes.** We conducted a Spearman's rho correlation for the one-zero ethogram sampled behaviors in conjunction with abnormal repetitive behavior. Behaviors were coded as abnormal and repetitive if they occurred in a repetitive sequence with no function. In order for a behavior to be coded as an ARB, the otter would have to engage in a specific behavior three times consecutively without doing another action in between. Tilly engaged in locomotor ARBs, these included a sequence of several behaviors: Push-off surface p=.512, Backward dive p=.310, Forward somersault p=.033, and Underwater swim p=.207. We recorded these behaviors together as an infinity sequence. Additionally, specific sequential behaviors of the Infinity Sequence were positively correlated with ARBs, rho(9216) =.09, p=.048, Visitor Effect Score, rho(495) =.18, p<.001, Visitor Number, rho(495) =.20, p<.001. Somersault with Foot-in-Mouth and ARBs, rho(9216) =.23, p<.001, as well as Visitor Number, rho(9224) =.04, p<.001 and Visitor Effect were positively correlated, rho(9202) =.07, p<.001, Displacement, rho(9268) =.05, p<.001 (See Table 3 for Correlation Matrix). An independent samples t-test indicated a side bias relative to Foot Preference for the behavioral sequence of, Somersault with Foot-in-Mouth and ARB, with clear bias for the Left Foot (n=115, M =.98 SD=.13), relative to the Right (n=34, M=.53, SD=.75), t(1,147)=-6.23 , p<.001.

✓

2. *For the matriarch, Tilly, does parenting context affect the presence and frequency of repetitive behavior?*

✓ **Yes,** we conducted a 4 (Parenting Phase) x 7 (Enclosure Zone) univariate analyses of variance for observed abnormal repetitive behaviors. There was a main effect by parenting phase and abnormal repetitive behavior, F(3, 9299)=3.22, p=.049, η^2 =.37 and an interaction between Parenting Phase and Zone, F(15,9299)=158.76, p=.001, η^2=.21; but, no main effect for Enclosure Zone and ARBs, F(7,9299)=.89, p=.54 (See Table 2 for Descriptives, and Table 4 for graph).

3. *If all otters engage in abnormal repetitive behavior, did Tilly engender her ARBs to the rescued juvenile otters (i.e., foster otters)?*

No, the qualitative results demonstrated that Flora and Hobson mimicked some of Tilly's behaviors. Flora and Hobson followed Tilly as she was engaging in her infinity sequence, as well as interacted with the visitors at the glass of the exhibit. Although Tilly's repetitive behavior persisted across all phases of parenting, there were no significant behavioral associated with abnormal repetition and the ethogram behaviors for Tucker and Nellie (relocated, biological otters), or Flora and Hobson (current rescued, foster otters). This suggests that Tilly's ARBs have not been encultured across introduced or biological offspring.

Table 1. Captive North American River otter Ethogram

Welfare Variables (6)	
Feeding	Otters are provided food during the behavioral scan, they may or may not eat.
Enrichment	Enrichment number is the number of enrichment items present in exhibit (e.g., puzzles, Kong toys, water bottles, fish popsicles, etc.)
Enrichment Type*	Qualitative description of each type of enrichment in the exhibit
Visitor No.	Number of visitors at any given time observing the exhibit (starting with observers)
VES	Visitor Effect Score, subjective scale of 1-10 that describes how loud, invasive visitors are.
Displaced	Following a disturbance or an event, the otter immediately departs one location for another.
Displaced To*	Describes the starting and the ending zones following the disturbance that displaced the animal (e.g., 1-2; 5-3, etc.)
ARB	Abnormal repetitive behavior, any repetitive, unvarying, and apparently functionless behavior that is atypical in a natural environment
ARB Sequence*	Qualitative description of each ARB in sequence
Rest/Eat (4)	
Sleep Number	Number of otters sleeping concurrently (typically in Zone 6)
Food Suckle	Established ARB, while sleeping (typically Tilly), otter mouths or sucks one (L/R) or both hind feet
Eat	Ingestion of food (not simply appetitive behavior, but consumption)
Beg	Involves clear solicitation or door-monitoring prior to feeding.
Affiliative/Agonistic (12)	
Directed Gaze	Directed gaze or eye contact with one or more of the visitors
Chase/Follow	Tailing, chasing or following another otter (or keeper)
Somersault	Somersault may start as a roll, but is head over feet and can occur as an ARB.
Foot-Grab	An established ARB wherein the otter holds one or both feet while somersaulting. this describes which foot (L or R or Both)
Grapple	Grappling, wrestling, tumbling, or rolling with another otter
Side)Saddle	Describes a play behavior, wherein one otter "saddles" atop another, different from "mounting," often occurs as "side saddle"
Enrichment Play	Otter "plays" with enrichment, may be to mouth, toss, carry – may also use platform or food as play target
Muzzle	Nudges, grooms or licks at the body or pelage of a conspecific
Table 1 continued	
Self-Groom	Tug, scratch, lick, or strokes their own pelage ("muzzle" in a conspecific)
Allogroom	Tug, scratch, lick, or strokes another otter
Nip	Non-aggressive, grabbing or nipping at another
Mount	Sexual or behavioral dominance, often with a neck bite
Aggression	Aggressive directed behavior (e.g., biting, hissing, open-mouth lunge at another otter, keeper, or at the exhibit glass)
Locomotion/Investigation (13)	
Forage	Appetitive, goal-directed behavior, toward food or enrichment, in water or land
Nessy	Otter swims with eyes above water level, hind quarters breeching the water as they float. Looks like the Lochness monster profile.
Periscope	Otter floats vertically in the water column, head and shoulders above water level – often occurs concurrent with "vigilance"
LieSwim	Swimming activity underwater, breath held
SurfSwim	Swimming activity at the surface
ForDive	Otter tucks their head underwater and pinches their head to tail, thrusting the tail above their head to propel themselves to depth
BckDive	Tail thrust forward, back arched into backward dive, generally occurs less often than forward dive
Push-Off	Otter pushes off an exhibit surface (typically hind legs) to initiate a swim
Roll/Rub	May shake off water, roll in the dirt, or rub in the dirt, all usually to dry off.
Amble	Akin to "walk" though shorter front limbs make "walking" a poor description
Gallop	Akin to "run" though again "gallop." is more representative of otter running
Spraint	Otter engages in the "latrine dance" to urinate, defecate, or both
Scent	Otter smells the latrine site, or the genital/anal area of a conspecific

Table 2. Descriptives for Parenting Phase, Zone and ARB

Phase by Zone	Total ARBs, N=9314, M (SD)	Fostering, N=2491, M (SD)	Nonparenting, N=1719, M (SD)	Nonparenting and Pregnant, N=3106, M (SD)	Parenting, N=4240, M (SD)
Total ARBs	.19 (.39)	.30 (.60)	.30 (.46)	.31 (.46)	.04 (.20)
Zone 1, Land Behind Logs	.04 (.19) N=54	---	---	1. (00) n=2	---
Zone 2, Logs, Platforms, Waterfall	.13 (.34) N=78	---	.33 (.58)	.64 (.50)	---
Zone 3, Latrine Site	.61 (.49) N=1550	.24 (.44)	.08 (.27)	.83 (.38)	.01 (.09)
Zone 4, Openwater	.18 (.40) N=3549	.44 (.73)	.41 (.49)	.31 (.47)	.06 (.24)
Zone 5, Land between 1 & 3	.02 (.14) N=404	.38 (.52)	.06 (.25)	.02 (.14)	---
Zone 6, Den	.03 (.19) N=3632	.08 (.33)	.17 (.38)	.01 (.08)	.02 (.13)
Zone 7, Behind Zone 1 & Off Exhibit	.24 (.44) N=32	--	---	---	.24 (.44)

Table 3. Behavioral events and Correlations

Behavioral Events	ARB	VES	Visitor #	Displacement	Somersault with Foot	Infinity Sequence
ARB	---					
VES	-.03** N=9194	---				
Visitor No.	.12** N=9264	.43** N=10170	---			
Displacement	-.08** N=9269	.02** N=9206	-.001 N=9228	---		
Somersault with Foot	-.029** N=9194	.07** N=9202	.04** N=9224	.05** N=9268	---	
Infinity Sequence	.02** N=9271	.18* N=495	.20** N=495	-.12** N=471	-.40** N=474	---



Image Credit, Oregon Zoo

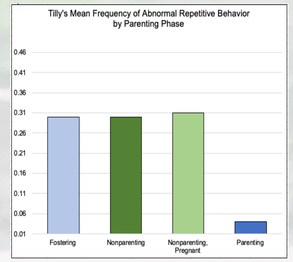



Image Credit, Oregon Zoo

CONCLUSIONS

- The first empirical question assessed if the Oregon Zoo North American River otters engage in ARB's, and based on the quantitative results, Tilly did in fact engage in ARB's across parenting phases. Tilly engaged exclusively in locomotor, sequential ARBs that we referred to as an infinity sequence. We saw that Visitor Effect and Visitor Number scores were positively correlated with her infinity sequence, meaning that the more people there were at the exhibit, and the louder they were, the more she would engage in ARBs
- In order to answer the second question of parenting context as a moderator for abnormal repetitive behavior and frequency, we conducted a 4 (Parenting Phase) x 7 (Enclosure zone) univariate analysis of variance with the dependent variable of abnormal repetitive behaviors. A significant main effect was found. Sequential order of least ARB occurrences to highest is biological parenting phase, non-parenting and fostering are tied for second, and the highest being non-parenting while pregnant.
- This study is important as it further supports the limited research investigating the mediating effect of parenting on captive animal wellness and potentially, the moderating effect of parenting on ARBs. Although Tilly's repetitive behaviors persisted across all parenting phases, there were no significant behaviors associated with abnormal repetition and ethogram behaviors for the foster pups. This suggests Tilly's ARBs have not been encultured across introduced or biological offspring.
- It may be meaningful to look at Tilly's biological pups and foster pups activity budgets in the future and using focal sampling to identify behaviors if they occur. Additionally in place of visitor density or visitor effect score, it may be meaningful to use formal acoustic measurements within the exhibit as a more objective measurement.

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