Expression of The Enjoyment of Companionship in the Great Horned Owl (*Bubo virginianus*)

Craig T. Perdue[1] and Dwight P. Wynne[2]

[1]*Corresponding author, Shadow Speak, LLC, Ypsilanti, MI, USA. cperdue@shadowspeak.org, (734)262-0998*

[2]*Department of Mathematics, California State University, Fullerton, CA, USA.*

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Abstract: This is descriptive and exploratory research. Our focus is first, to build on earlier work by presenting a previously undocumented vocalization and accompanying behavior/context which most resemble the expression of the enjoyment of companionship in a Great Horned Owl (Bubo virginianus). Second, we draw attention to the only other source attributing companionship to virginianus. Those vocalizations are described qualitatively. We describe putatively similar vocalizations qualitatively and quantitatively from the data of 352 vocalizations we collected and examine their significance as another expression of enjoyment of companionship. We then place our findings in perspective.

Lorenz (1937) chose the word 'Kumpan' to unify various stimulus-response patterns in geese as these resemble companionship. The enjoyment of companionship between birds and other animals has been informally discussed extensively for various psittacines as "companion birds". For the purposes here, enjoyment is a mode of consciousness (in the Cartesian sense), and there is evidence for consciousness in non-human animals including the birds continuing to accrue from neuroscience, including the owls (Stacho et al. 2020). Enjoyment takes states as its objects; we construe states as Chisholm's states of affairs (Kim 1979). It has the quality of aboutness, much as propositions or statements do (Feldman 2002). Moreover, enjoyment may entail a "feeling", over and above pleasure, though what a feeling is and how to explicate them has been a longstanding problem. Whatever feelings are, the consensus view is that various classes of vertebrates and even invertebrates have them (de Waal and Andrews 2022).

Artuso et al. (2022) summarize the work in the field on the types of vocalizations of the Great Horned Owl (*Bubo virginianus*). However, these vocalizations remain very poorly understood. Where functions are given, Artuso attributes functions to vocalizations based on sources providing non-prospective case studies. The first author (CTP) engaged in over 12 years of collection and examination of primary and secondary sources (including video review of infrared remote nest monitoring) to document vocalizations of *Bubo virginianus virginianus* where at least some of the behavioral and contextual information is known. This amounted to 352 recordings from various individuals. 57 vocalizations given in distinct contexts are from one individual, Rupert, a semi-tame male from the Ypsilanti/Ann Arbor, Michigan area. These recordings span over eight years from owlet through adulthood. Our focus in this report is first, to build on Artuso's work by presenting a previously undocumented vocalization and accompanying behavior/context which most resemble the enjoyment of companionship. Secondly we seek to describe a type of vocalization qualitatively and quantitatively, and compare it to qualitative descriptions in Heinrich (1987), the only other source attributing companionship to *B. virginianus virginianus.* (There is no documentation for other subspecies.) We then put these in perspective.

Methods and Discussion

CTP recorded all of the vocalizations of interest in the field. The previously undocumented vocalizations were recorded opportunistically as .wav files with an Olympus Portable Hand-held Recorder DM-620 held approximately 20 centimeters away. The rest of the vocalizations were recorded using a Marantz PMD-661Mkiii Field Recorder with a Sennheiser ME 66 Shotgun Microphone. As available, recordings were made in 19 distinct types of contexts. Rupert was kept as a bird of falconry by the first author. Training using only positive reinforcement began within days of being introduced to his new home. CTP spent time daily

with Rupert, including visitation in his indoor enclosure, i.e., mew, a separate converted bedroom.

Spectrograms and waveforms and their associated quantitative measurements were extracted with Raven Pro 1.5.0 build 43. The following parameters were used: Window Type: Hann, Window Size: 512, DFT Size: 1024, Overlap: 90. Frequency was measured to a lowest limit of 60 Hz for two reasons. 60 Hz is the lowest frequency at which *B. virginianus* can hear (Edwards 1943), and there was a band of recording noise located below 60 Hz. We analyzed vocalizations using the following features: frequency (first and third quartile), duration, sound intensity (classified by CTP as low, medium, or high intensity relative to the other vocalizations), and the number of syllables.

The previously undocumented type of vocalization was recorded by CTP outside Ypsilanti, Michigan, in a vacant middle school parking lot at approximately 21:30 (EST), 16 October 2014, on a dark night. At the time of recording, he was approximately 8.5 months old. Rupert was recorded shortly after a free-flight exercise in a field adjacent to the school with a lit parking lot. He landed on asphalt, at the base of a lit light pole approximately six meters away from the first author. Rupert used a rapid side-to-side gait for 2 meters to get from a nearby flagpole to where the first author was seated on the pavement. He then situated himself in the author's lap in a prone position across the author's lap. He faced toward the school situated approximately 35 meters away. No other events occurred in the surrounding environment.

In this context, Rupert transmitted at least three faint pulses, with each pulse separated by approximately five seconds. A pulse has been described elsewhere for anurans as a single burst of sound energy, not further subdivided into subunits, separated by strong amplitude modulation from other pulses (Kohler et al. 2017). The pulses were recorded opportunistically as a result of the accompanying unique non-vocal behavior which strongly resembled the enjoyment of companionship. They could theoretically be the result of chaos or randomness, however they

occurred in a patterned series, and their functional role as expressing the enjoyment of companionship is *prima facie* evident (in exploratory research) given behavior and context. Further, the contextual and behavioral characteristics point to the occurrence of the enjoyment of companionship as the inference to the best explanation since, as far as we have been able to ascertain, no other explanation renders them as less surprising (Schupbach and Sprenger, forthcoming). For example, it is harder to see how a case for affection is as strong. Because *B. virginianus* is an intrinsically aggressive solitary animal, feeling affectionate toward another animal is therefore not likely *a priori*. Upon review of allopreening in this species in the literature, on the Internet, and in the first author's video archives, allopreening occurs between parent and offspring in the nest and among branchers. And there was one instance in adults of what presumably was a pair. Kenny et al (2017) describe a prevalent pair bond maintenance function for allopreening in birds. However, pair bonding does not entail affection. Because of prey-strewn nest conditions for this species, allopreening between parent and young may just as well play a hygienic (anti-parasite) function between parent and young. Because *B. virginianus* is occasionally cannibalistic between adults and there are crowded conditions among branchers, allopreening among branchers may perform a stress reduction strategy or provide heat conservation. The case described here - clearly not possible in virtue of these explanations - is more likely to obtain because it expresses a positive disposition toward the *state* of the agents being together.

The pulses recorded – vocalizations 348 and 349 - have a low frequency (ranging from Q1 = approximately 200 Hz to Q3 = approximately 600 Hz), and 30-40 ms in duration, at least four times briefer than any of the other 352 vocalizations. Both had an extremely low acoustic intensity, audible to the human ear only from a very close distance. Figure 1 presents the spectrogram of 348, closely resembling the other pulse recorded, vocalization 349.

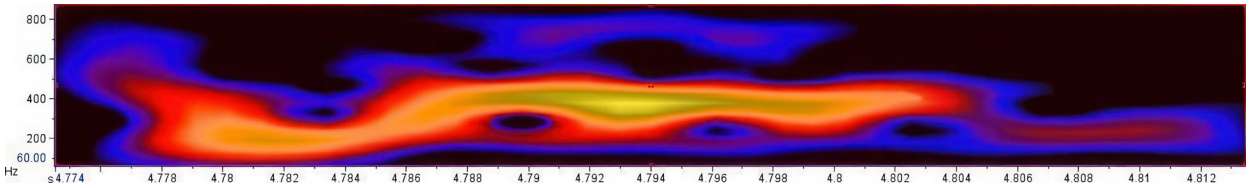

Figure 1. Subject Great Horned Owl Pulse (348)

If CTP and Rupert were companions, it is reasonable to have observed the behavior and vocalizations more than once. That is not the case here. At the time the behavior was observed, Rupert was a young bird, approximately eight months old. At some point subsequent to the pulses being recorded, the then relatively ignorant first author engaged Rupert in negative interactions over a period of several months in the process of forcing radio telemetry to be affixed. (Damage done has since been only recently overcome (after a process of years).) It is possible that the pulses reflect Rupert's developmental stage or these expressions reveal an intimacy that was lost due to the negative interactions.

There is only one other source where the enjoyment of companionship has been stated for *B. virginanus*. Heinrich coexisted in the same dwelling with his bird for years, and the bird was subject to minimal restrictions. Heinrich (1987) explicitly identifies one type of vocalization as expressing the enjoyment of companionship, or what he simply calls "companionship". According to Heinrich, "I hear them [vocalizations] only when I am next to him; they are his private sounds, reserved for intimacies…. It is these …that bond friendship." They are "…quick little nasal, reedy chuckles varying in tone".

Vocalization 16, also from Rupert, was the most audible of three like vocalizations of low intensity in the session in which it was recorded, which occurred approximately six months after the pulses (and well before the traumatic events described). These three vocalizations match the qualitative description given by Heinrich. None other of the 352 fit this description. Like 348 and 349, 16 was faint. Because of this and a noisier environment, its spectrogram is not perspicuous (fig. 2).

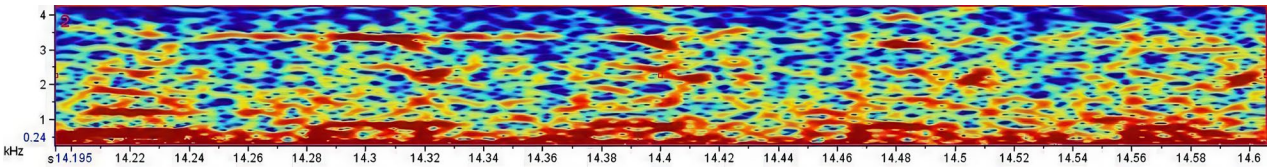

Figure 2. Vocalization 16

Though 16 had five syllables, it was still quite brief, 0.41 sec, with a syllable rate of approximately 12.2 syllables/sec. 16 has a frequency spanning approximately 400-650 Hz, similar to that of vocalizations 348 and 349. Both contribute to a similarity in this respect (fig. 3). The intensity level is the same as well.

To quantify how different the pulses were from the other vocalizations recorded from Rupert, we developed a metric representing the "distance" between any two vocalizations. We log transformed the duration, number of syllables, and Q1 and Q3 frequency and standardized each transformed variable to have mean 0 and standard deviation 1. For the intensity variable, we represented low intensity as -0.5, medium as 0, and high as 0.5. Finally, we computed the Euclidean distance between the vocalizations based on these transformed and standardized variables. This analysis was performed using R version 4.1.1 (R Core Team, 2021); graphics were produced using the package ggplot2 version 3.3.6 (Wickham 2016).

The minimum of the two distances to 348 & 349 was considered as the "overall distance" between a vocalization and the pulses. As shown in Figure 4, no other vocalization is closer to the pulses than 16.

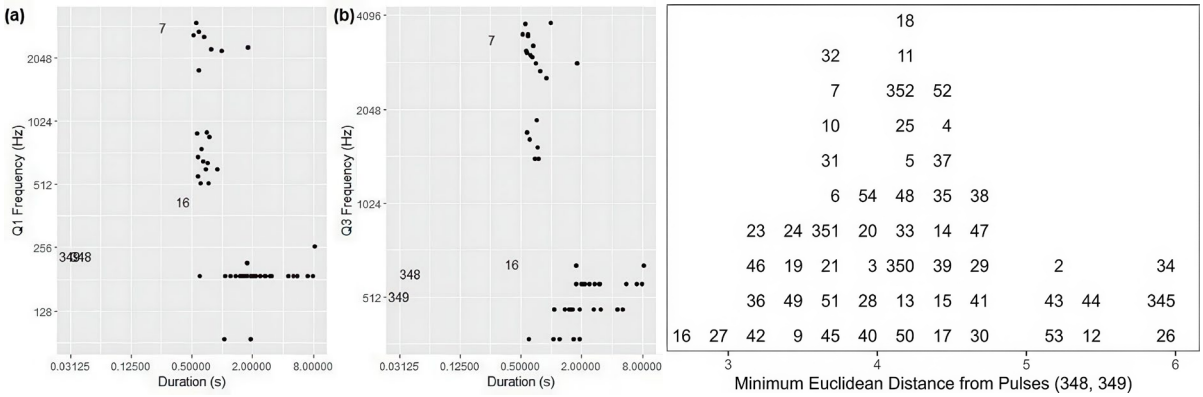

Figure 3. Frequency vs. Duration for all of subject's vocalizations

Figure 4. Minimum (Euclidian) distances from pulses (348, 349)

The context/behavior of 16 involved Rupert standing stationary on the ground in an area where Rupert had been trained before using strictly positive reinforcement. He stood stationary between two women who were lying and sitting on the ground flanking Rupert opposite one another. Each was approximately 6 meters from the bird. The women softly praised the bird in high, soft voices each time the bird vocalized, and soft encouragements presaged these vocalizations. 16 and its cohorts were the only vocalizations that occurred. Though there are other explanations of 16 with its accompanying behavior/context, the expression of companionship is also compatible.

For vocalization 16, its occurrences need to be further elucidated. From Heinrich's work, vocalizations which resemble it appear to express the enjoyment of companionship. For the

pulses, their associated behavior and context certainly point to that dispositional attitude. Perhaps Rupert and Heinrich's owl are unique, anomalous cases. That at least appears doubtful to us. However, corroborating evidence is necessary. That may be attainable because both birds exhibited their behavior with allospecifics in captivity, and because the occurrence of this species is widespread in the network of zoos and rehabilitation facilities.

The challenge of the reproducibility of our findings is daunting because documentation for a development of antecedent conditions does not exist for the Great Horned Owl. Though it is anecdotal, it is beyond speculation that CTP contends that this can be done with sufficient detail. There are also a number of intriguing testable hypotheses related to similarity of the acoustic properties described here and commonalities in functional role. Of course, there are questions about how to provide the best welfare of individuals kept in captivity (perhaps including other strigids). As an intrinsic good on hedonistic grounds (Feldman 2010) and other moral theories, their enjoyment merits the effort.

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There are no competing interests to declare.

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The authors confirm that the research meets any required ethical guidelines, including adherence to the legal requirements of the United States Fish and Wildlife Service and the United States Department of Agriculture Animal Welfare Act standards for birds.

The data constitute part of an ongoing project and it will be publicly available once this project comes to an end.

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