Papers & Publications: Interdisciplinary Journal of Undergraduate Research

Volume 6 Article 10

2017

Human Facial Recognition by Northern Mockingbirds

Jessica A. Stehlin
University of North Georgia

Janice Crook-Hill
University of North Georgia

Brad Bailey
University of North Georgia

Human Facial Recognition by Northern Mockingbirds

Acknowledgments
We thank the UNG Center for Undergraduate Research and Creative Activities and the University of North Georgia Department of Biology for funding and logistical support. We also thank Nadia Tinoco and students from the University of North Georgia ornithology class for field assistance.

Human Facial Recognition by Northern Mockingbirds

Jessica Stehlin;
Janice Crook-Hill, PhD;
and Brad Bailey, PhD
University of North Georgia

Numerous studies have examined the ability of animals to recognize individual humans. Examples of such animals include rabbits, marine mammals, sheep, domesticated dogs, and more (Davis & Gibson 2000; Pierce et al. 2001; Mongillo et al. 2010; Taylor et al. 1998). Additional studies have indicated that many species of wild birds such as sparrows, pigeons, magpies, and others also possess this ability (Vincze et al. 2015; Lee et al. 2011; Belguermi et al. 2011).

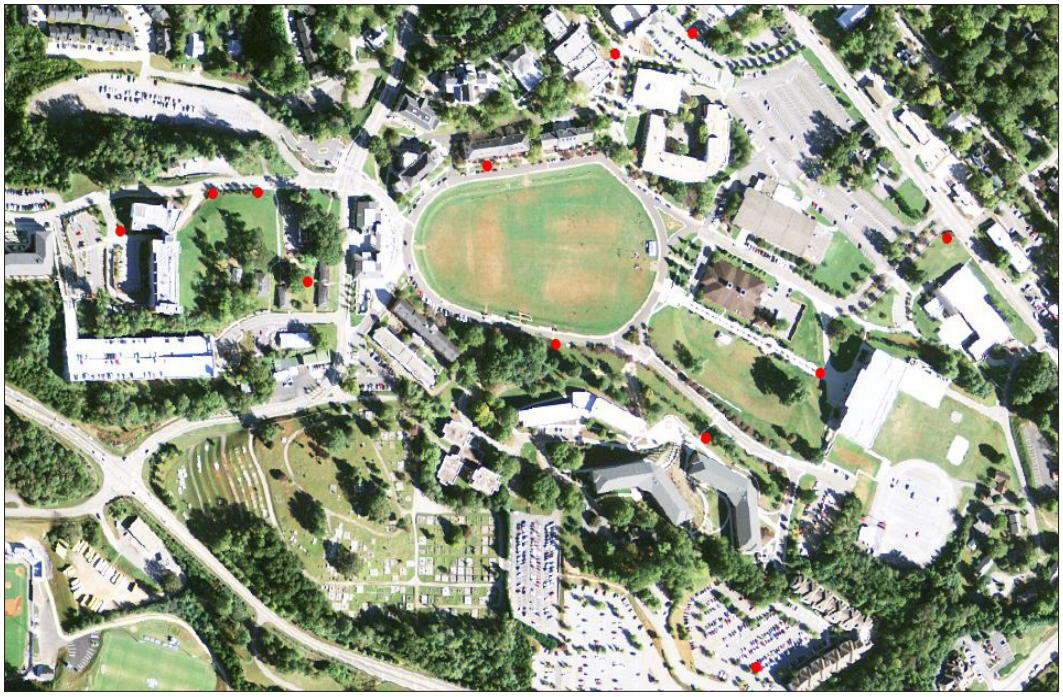
The ability to recognize individual humans can be particularly important to wild birds living in urban environments. Although many bird species are negatively impacted by increasing urbanization, especially due to habitat loss and increased predation risk, other species demonstrate an ability to adapt to these environmental changes and may even benefit from additional food sources or nesting sites (Marzluff, 2001). American Crows (*Corvus brachyrhynchos*) and Northern Mockingbirds (*Mimus polyglottos*) are two species that successfully live and reproduce in urban areas. Research by Marzluff et al. (2010) indicated that wild American Crows are able to distinguish between masked humans that posed a threat to their well-being and those that did not, by learning and remembering facial features that enabled them to distinguish one individual from another. In a study by Levey et al. (2009), researchers found that mockingbirds are capable of learning to distinguish among individual humans; however, the factors involved in discrimination were not examined.

We studied Northern Mockingbirds on the University of North Georgia campus, in Dahlonega, Georgia, to test the hypothesis that mockingbirds learn to distinguish among individual humans based on facial recognition (Fig. 1). Mockingbirds are year-round residents of towns, suburbs, and parks throughout much of North America. Pairs may attempt to raise two or three broods per breeding season, with incubation and nestling periods lasting approximately 12 – 13 days each (www.allaboutbirds.org, n.d.). Nests are often in close proximity to homes and other buildings, and many birds encounter humans on a daily basis. Because of their close association with humans, recognition of individual humans may be of adaptive significance to mockingbirds. Since most humans pose no threat, energy spent on aggressive responses toward non-threatening humans reduces time and energy available for foraging and raises predation risks (Marzluff, 2010). Our study combined aspects of both the Marzluff et al. (2010) and Levey et al. (2009) studies. We followed the protocol used in the Levey mockingbird research to test the

Jessica Stehlin is an undergraduate student at the University of North Georgia, where she is pursuing a B.S. in Environmental Spatial Analysis. Her research interests focus on the interactions between humans and the natural environment. **Dr. Janice Crook-Hill** is an Assistant Professor of Biology at the University of North Georgia in Dahlonega, Georgia, where she teaches introductory and upper-level courses, including ornithology, and co-teaches a study abroad course in Costa Rica. She studies the evolution of behavior in birds and she has mentored students in research projects including monitoring a declining population of Golden-winged Warblers in North Georgia, recording and analyzing vocalizations of nocturnal migrants, exploring cross-species responses to vocalizations of humans and birds and human facial recognition by Northern Mockingbirds. **Dr. Brad Bailey** is a Professor of Mathematics at the University of North Georgia.

Figure 1. Northern Mockingbird on the University of North Georgia's Dahlonega campus.

Figure 2. Map of mockingbird nests on the University of North Georgia campus.



ability of mockingbirds to discriminate among individual humans. We also wore masks, as in Marzluff's crow research, to determine whether any demonstrated discrimination ability is based on facial cues. This may further understanding of how some species of birds and other wildlife successfully adapt to human presence.

Materials and Methods

Over a period of several weeks in 2014 and 2015, we observed and noted the activities of wild mockingbirds on the University of North Georgia campus, identifying twelve nesting pairs and nest locations (Fig. 2). To test the ability of mockingbirds to recognize individual humans, we used a five-day procedure, patterned after the protocol used by Levey, et al. (2009). In addition to following the basic Levey protocol, we wore masks, one of Bill Clinton and one of Ronald Reagan, to determine whether mockingbirds use facial features to differentiate among humans. These masks were chosen because they were the most "normal" human face masks that were readily available.

The five-day procedure was performed at twelve nests during the incubation period. For days 1–4, a researcher (dubbed "intruder" for the rest of the procedure) wearing Mask A approached an incubating mockingbird on a nest (Fig. 3). In some, but not all, cases, the second parent was observed nearby. Masks were alternated, so at some nests mask A was Clinton, and at others it was Reagan. An additional researcher, standing away from the testing site and

Figure 3. One of the authors, acting as an intruder, wears a mask while touching a mockingbird nest on the University of North Georgia campus.

hidden from the mockingbird, started a timer when the intruder was one meter away from nest. After 15 seconds, the intruder touched the nest with their hand for an additional 15 seconds. (If the bird's nest was too high to reach by hand, the intruder used a wooden pole to touch the nest.) After the combined 30 seconds, the intruder retreated from the nest. On day 5 of the procedure, an intruder wearing Mask B performed the same protocol. The fifth day was important to determine whether birds that respond aggressively to a threatening human generalize and continue to respond aggressively to all humans, or whether birds distinguish between a previously threatening human and a novel human who has posed no threat. Intruders were usually the authors, with occasional help from other individuals. Intruders alternated randomly, with no set pattern from day to day. We made no attempt to control aspects of the intruder other than the mask.

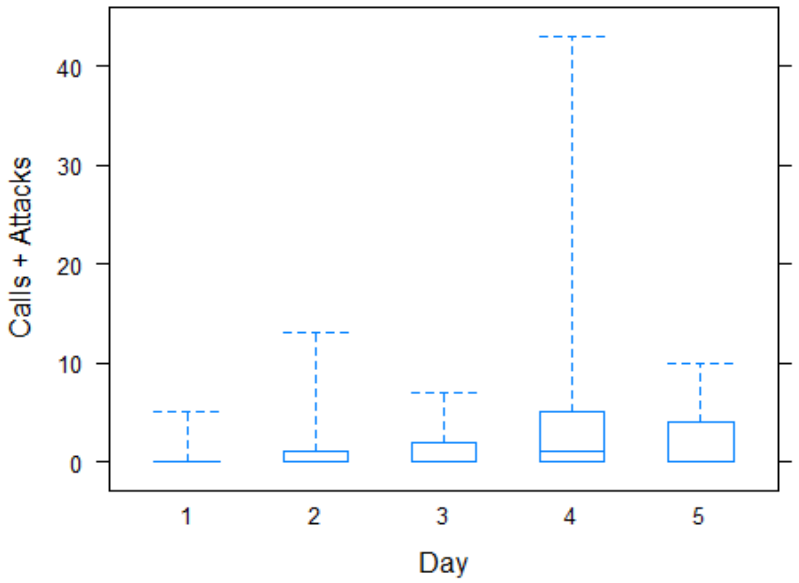
After the intruder had retreated from the nest after each test, researchers recorded the number of calls and/or attacks from the birds, the time and distance of response, and a detailed description of the birds' behavioral response to the procedure. For the purposes of this study, we remained consistent with the definitions of calls and attacks cited in Levey et al. (2009). Calls were loud, harsh vocalizations produced by the birds. A "swooping flight" was considered to be an attack.

We analyzed results using a Kruskal-Wallis H-test followed by pairwise Wilcoxon rank sum tests, to determine if there was a difference in response by day and if so which days had higher or lower responses.

Results

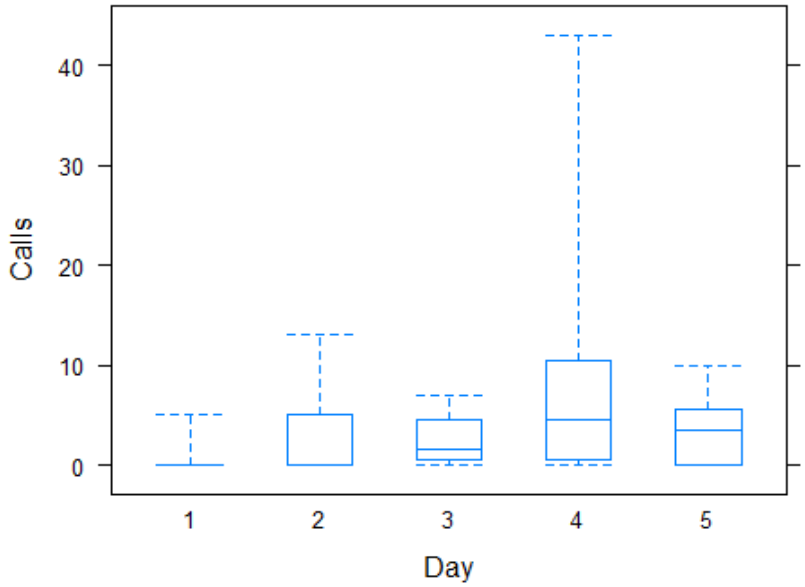
Combining results of the twelve nests, six exhibited increased aggressive responses through day 4, but a novel intruder on day 5 did not elicit an aggressive response. Two nests exhibited mixed results, where number of calls increased on day 5, but number of attacks decreased, or number of attacks increased but number of calls

Figure 4. Combined number of alarm calls and attacks of incubating mockingbirds toward human intruders on days 1 through 5.



The number of calls and attacks on day 4 was significantly higher than number on day 1, and decreased on day 5 ($H = 11.34$, 4 df, $P = 0.023$, pairwise Wilcoxon rank sum test for day 4 versus day 1, $P = 0.042$). A boxplot consists of up to five lines, indicating the values of the minimum, the first quartile, the median, the third quartile and the maximum; when some of these lines appear to be missing that indicates that the corresponding values coincide.

Figure 5. Number of calls of incubating mockingbirds toward human intruders on days 1 through 5.



The number of calls tended to increase up to day 4, and decrease on day 5. (H = 10.962, P = 0.027, pairwise Wilcoxon rank sum for day 4 versus day 1, P = 0.046).

decreased. One nest exhibited an aggressive response on day 5 that exceeded the previous days' responses, and pairs at three nests exhibited no response at all, even though at least one bird was present when the test began. In all cases of aggressive response, two birds (presumably both parents) participated in the response, even if we only saw the incubating bird initially.

The pair at one nest in particular, which was in a tree in front of the campus library, was particularly striking. There was no response on day 1, the pair became increasingly and extremely aggressive over the initial four days of testing, with both parents nearly striking the intruder with swoops, but had no response to the novel individual on day 5.

Using R (R Core Team, 2016), we performed a Kruskal-Wallis H-test followed by pairwise Wilcoxon rank sum tests, to determine if there was a difference in response by day and if so which days had higher or lower responses. With the pairwise Wilcoxon rank sum tests, we used the Bonferroni adjustment to account for multiple comparisons. A Bonferroni adjustment consists of multiplying each resulting p-value by the total number of tests run at once (in this case, 10); the purpose of this adjustment is to lower the risk of Type I Error. These tests were selected because they do not depend upon either the sample or the original population being normal. Graphs were generated using commands from the Mosaic package (Pruim, Kaplan & Horton, 2016).

We found that the combined number of calls and attacks on day 4 was significantly higher than on day 1. The trend was an increase up to day 4 followed by a decrease on day 5 (Fig. 4, H = 11.34, 4 df, P = 0.023, Wilcoxon rank sum test for day 4 versus day 1, P = 0.042). The number of calls on day 4 was also significantly higher than the first day (Fig. 5, H = 10.962, P = 0.027, pairwise Wilcoxon rank sum for day 4 versus day 1, P = 0.046), but the difference in number of attacks was not significant (H = 6.006, P = 0.199, pairwise Wilcoxon rank sum for day 4 versus day 1, P = 0.37). Distance did not seem to be a factor; in all cases, the intruder was within one or two meters before eliciting a response.

Table 1, which displays the unadjusted p-values for the pairwise Wilcoxon Rank Sum tests for both Calls and Calls plus Attacks, shows

Table 1: Unadjusted p-values for the pairwise Wilcoxon Rank Sum tests.
The reader can apply a Bonferonni adjustment, by multiplying each of these by 10; the * indicates which of these is significant after such an adjustment.

	Calls and Attacks				Just Calls			
	Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
Day 2	0.1499				0.1595			
Day 3	0.0140	0.4713			0.0139	0.4173		
Day 4	0.0042*	0.0872	0.2202		0.0046*	0.1114	0.2095	
Day 5	0.0143	0.3462	0.6392	0.3488	0.0169	0.4289	0.6593	0.3051

that the only day that is statistically significantly different from any other is day 4, which is significantly higher than day 1. This shows an increase from the first day to the fourth. It is worth noting that while the decrease from day 4 to day 5 is not statistically significant, day 5 is also not significantly different from days 1 through 3 either.

Discussion

As the modern world continues to become increasingly urbanized, it is important to understand whether urban wildlife possesses the ability to adapt to these changing environments. According to Vincze et al. (2015), the ability of animals to cope with disturbance by and proximity to humans may play an important role in adaptation to urban environments. In their study of House Sparrows, urban birds were less likely than rural birds to differentiate between a novel human and one who had previously posed a threat, suggesting that perhaps urban sparrows habituate to the presence of humans and save energy by not responding to them. On the other hand, Lee, et al. (2016) found that Antarctic Brown Skuas living in close proximity to Antarctic research stations were able to recognize humans who had disturbed their nests, even though skuas in other populations do not demonstrate the ability, and even though the research stations have only existed for a relatively short time period.

Our observations that mockingbirds increase the combined number of alarm calls and attacks, and the number of alarm calls, on day 4 as compared to previous days, but have a diminished response to a novel intruder on day 5, are similar to the results of Levey, et al. (2009). These results indicate that mockingbirds can distinguish among individual humans based on the threat the individuals pose. This suggests that the human recognition ability of mockingbirds may enable them to fine-tune their responses to exhibit aggression only toward humans who pose an actual threat. Our data add to Levey's results by indicating that mockingbirds use facial features to discriminate among humans. The use of facial features as cues is similar to that of crows in Washington State (Marzluff, et al. 2010). One aspect of our data which differed from the Levey study was that there was no discernable change in the distance at which birds responded. Even birds that increased aggressive responses toward intruder one rarely responded before the intruder was within one or two meters of the nest.

Levey speculated that mockingbirds did not evolve a specific ability to recognize humans. Instead, he suggested that mockingbirds are able to quickly learn to distinguish among individuals of a variety of species that are potential predators, and that they tailor their response based on experience with specific individuals regardless of species. This may be a significant reason for their success in urban areas where they are likely to encounter a variety of animals that may pose a predation risk.

Further study is warranted to determine how mockingbirds and other animals adapt to living in close proximity with humans, whether their discrimination abilities have evolved in response to particular species or can be applied to a number of species, and which features of other species enable recognition.

References

Belguermi, A., Bovet, D., Pascal, A., Prévot-Julliard, A.C., Saint Jalme, M., Rat-Fischer, L. and Leboucher, G. 2011. Pigeons discriminate between human feeders. *Animal Cognition 14*: 909–914.

Cornell Laboratory of Ornithology. n.d. Northern-Mockingbird. http://www.allaboutbirds.org/guide/Northern_Mockingbird/id.

Davis, H., and Gibson, J.A. 2000. Can Rabbits Tell Humans Apart?: Discrimination of Individual Humans and Its Implications for Animal Research. *Comparative Medicine 50*: 483-485.

Lee, W.Y., Lee, S., Choe J.C., and Jablonski, P.G. 2011. Wild birds recognize individual humans: experiments on magpies, *Pica pica*. *Animal Cognition 14*: 817–825.

Lee, W.Y., Han, Y.D., Lee, S., Jablonski, P.G., Jung, J.W., and Kim, J.H. 2016. Antarctic skuas recognize individual humans. *Animal Cognition 19*: 861-865.

Levey, D. J., Londono, G. A., Ungvari-Martin, J., Hiersoux, M. R., Jankowski, J. E., Poulsen, J. R., Stracey, and C.M. Robinson, S. K. 2009. Urban mockingbirds quickly learn to identify individual humans. *Proceedings of the National Academy of Sciences 106*: 8959-8962.

Marzluff, J.M. 2001. Worldwide urbanization and its effects on birds. In: *Avian Ecology and Conservation in an Urbanizing World*. Marzluff, J.M., Bowman, R., and Donnelly, R., eds. Springer, New York. pp. 19-47.

Marzluff, J.M., Walls, J., Cornell, H.N., Withey, J.C., and Craig, D.P. 2010. Lasting recognition of threatening people by wild American Crows. *Animal Behaviour 79*: 699-707.

Mongillo, P., Bono, G., Regolin, L., and Marinelli, L. 2010. Selective attention to humans in companion dogs, *Canis familiaris*. *Animal Behaviour 80*: 1057-1063.

Pierce, J.W., Leigh, A.E., daCosta, A.P.C, and Kendrick, K.M. 2001. Human face recognition in sheep: lack of configurational coding and right hemisphere advantage. *Behavioural Processes 55*: 13–26.

Pruim, R., Kaplan, D.T., and Horton, N.J. (2016). mosaic: Project MOSAIC Statistics and Mathematics Teaching Utilities. R package version 0.14.4. https://CRAN.R-project.org/package=-mosaic

R Core Team (2016). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/.

Taylor, A., Davis, H., and Boyle, G. 1998. Increased vigilance toward unfamiliar humans by harbor (*Phoca vitulina*) and Gray (*Halichoerus grypus*) seals. *Marine Mammal Science 14*: 575–583.

Vincze, E., Papp, S., Preiszner, B., Seress, G., Liker, A., and Bókony, V. 2015. Does urbanization facilitate individual recognition of humans by house sparrows? *Animal Cognition 18*: 291–298.

Acknowledgements

We thank the UNG Center for Undergraduate Research and Creative Activities and the University of North Georgia Department of Biology for funding and logistical support. We also thank Nadia Tinoco, Cally Orr, and several students from the University of North Georgia ornithology class for field assistance.