

Ketterson / Nolan Research Group Collection

This document is part of a collection that serves two purposes. First it is a public archive for data and documents resulting from evolutionary, ecological, and behavioral research conducted by the Ketterson-Nolan research group. The focus of the research is an abundant North American songbird, the dark-eyed junco, *Junco hyemalis*, and the primary sources of support have been the National Science Foundation and Indiana University. The research was conducted in collaboration with numerous colleagues and students, and the objective of this site is to preserve not only the published products of the research, but also to document the organization and people that led to the published findings. Second it is a repository for the works of Val Nolan Jr., who studied songbirds in addition to the junco: in particular the prairie warbler, *Dendroica discolor*. This site was originally compiled and organized by Eric Snajdr, Nicole Gerlach, and Ellen Ketterson.

Context Statement

This document was generated as part of a long-term biological research project on a songbird, the dark-eyed junco, conducted by the Ketterson/Nolan research group at Indiana University. For more information, please see IUScholarWorks (<https://scholarworks.iu.edu/dspace/handle/2022/7911>).

License/Disclaimer Statement

By downloading this document or using any information contained therein, you agree to the license terms outlined at <https://scholarworks.iu.edu/dspace/handle/2022/15256>, which explain terms governing use, creation of derivative research, and requirements for citing the document.

Discrimination of Conspecifics, Heterospecifics, and Populations: A Study of Avian Olfactory Capabilities

Allison K. Miller and Danielle J. Whittaker

Center for the Integrative Study of Animal Behavior, Indiana University

a3miller@ucsd.edu



Introduction

Recent studies have unearthed the importance of olfactory cues in avian social interactions. We examined the olfactory discrimination abilities of the dark-eyed junco (*Junco hyemalis*).

Questions we asked:

1. Can juncos discriminate between scents of a conspecific and a heterospecific (brown-headed cowbird, a brood parasite)?
2. Can juncos discriminate between the scents of conspecific populations different from their own?
3. Can juncos discriminate between the scents of male and female conspecifics?

Background

- Chemosignals are substances that influence the physiology or the behavior of animals receiving the signal.
- Chemosignals can be volatile or non-volatile.
- It is unknown whether birds use these substances; however, volatile compounds have been found in preen oil (Figure 1) that vary predictable by both sex and population (Figure 2).
- Understanding whether birds can discriminate between conspecific and heterospecific scents is one of the first steps to understanding avian chemosignals.
- If discrimination exists, scents could be potential factors in mate selection and brood parasitism defense.

Materials and Methods

To test the olfactory discrimination capabilities of the dark-eyed junco, we conducted habituation-discrimination trials during July of 2009.

Subjects

- Juncos from three populations were studied: Laguna Mountain (LM), CA; University of California San Diego campus (UCSD), CA; Virginia (V)

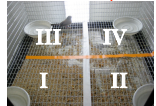
Preen Oil Extraction

- Preen oil was used as the main scent source from all subjects
- Oil was extracted from the uropygial gland



Trials

- 30 min trials consisted of two phases: first, a 20 min habituation phase and second, a 10 min discrimination phase
- Scents: habituation (H) scent - familiar donors (same population/sex as subject) and discrimination (D) scent - novel donors (heterospecifics, different population/sex); 2 controls: blank (B) and pure acetone (A)
- Preen oil scent solutions made by dissolving 1 mg preen oil in 100 ul acetone and presented in empty dishes - 1 dish per quadrant of floor of subject's cages; dishes randomly distributed, replaced between phases
- Habituation phase: H, A, B, B presented
- Discrimination phase: H, D, A, B presented
- Subject predicted to habituate to habituation scent and then predicted to spend more time exploring the novel discrimination scent



Results

Preliminary Results

Male Junco Preen Oil Composition

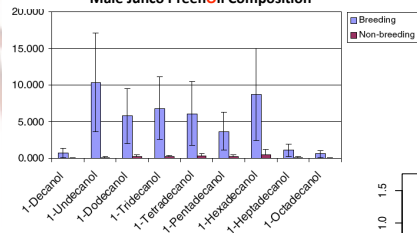
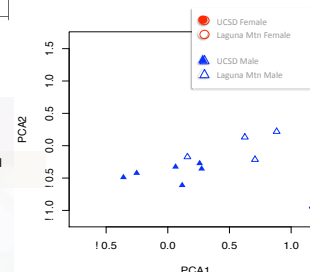


Figure 1. Comparison of breeding and non-breeding season linear alcohols (Soini et al 2007).

Figure 2. Principal components analysis of 19 junco preen oil volatile compounds (Whittaker and Soini unpublished data).



Current Status

Heterospecifics:

- Subjects: 9 LM females, H's: LM and UCSD females, D's: female brown-headed cowbirds

Discrimination Phase of Cowbird Trials

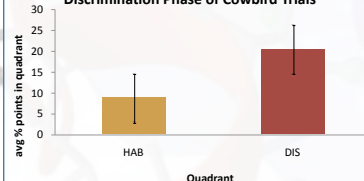


Figure 2. The average percentage of time points in quadrants containing the habituation scent (HAB) and the discrimination (DIS) scent during the discrimination phase ($\chi^2 = 19.025$, $df=8$, $p=0.01$).



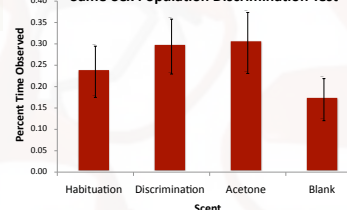
Conspecific Populations:

- Subjects: 9 LM and 16 UCSD females, H's: LM and UCSD females, D's: UCSD and V juncos

Figure 4. The average percent time spent by subjects in each quadrant containing a specific scent.



Same-Sex Population Discrimination Test



Male/Female Conspecifics:

- Data are currently being analyzed blindly via Odlog software
- We predict females will be able to discriminate between the scents of female and male conspecifics.

Current Difficulties:

- Stereotypic movements

Conclusion

Heterospecifics

- *Junco hyemalis* females are able to discriminate between the scents of a heterospecific brood parasite and a conspecific.
- However, in the wild, juncos are frequently parasitized by cowbirds and do not respond behaviorally, perhaps because they can often successfully reproduce even while raising cowbird nestlings.
- Future studies testing the discrimination abilities of species known to behaviorally respond to brood parasitism would be beneficial.

Conspecific Populations

- Our current data do not suggest that females can differentiate among same sex conspecifics from different populations.
- In the future we plan to test whether juncos can differentiate between opposite sex birds from different populations which would be more relevant in the context of mate choice.

Male and Female Conspecifics

- Data is currently being analyzed



Acknowledgments

A special thanks to Jonathan Atwell, Elizabeth Ansert, Meelyn Pandit and Ryan Kiley for all of their help at the farm.
Thank you to Ellen Ketterson and everyone at the Ketterson Lab.
And thank you NSF, CISAB, and IU for making this all possible.



References

1. Halpin. 1974. Behavioral Biology. 11:253-259.
2. Soini et al. 2007. J. Chem. Ecol. 33:1573-1561.
3. Tang-Martinez and Bixler. 2009. J Chem Ecol. 35:400-404.