

Do Zebra Finches Avoid Feeding Locations Used by Sick Birds?

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Abstract:

Pathogens play a key role in population dynamics. A number of species avoid the increased risks of infection inherent to group living by avoiding individuals they know to be sick. It would seem that individuals would experience similar fitness benefits by avoiding sharing resources with individuals that they know to be sick. By avoiding these resources, they avoid a possible source of infection. Despite these apparent benefits, a recent study has shown that male House Finches preferentially feed near sick, rather than healthy, conspecifics. There are a number of immunological and social tolls that occur when male finches lose in aggressive interactions, incentivizing the birds to feed near individuals that they perceive to be weaker. In this study we investigated the preference, in the absence of competition, of Zebra Finches for food resources used by a healthy neighbor and a neighbor showing symptoms of infection. We found that, when allowed to feed in the absence of costly social competitions, Zebra Finches appear to select resources at random, despite having observed sick conspecifics using these same food resources.

Introduction:

Pathogens play an essential role in the population dynamics of animal species. Evidence suggests that the burden placed upon populations by organisms such as viruses, bacteria, and parasites may be just as important in limiting populations as other common factors such as predation or resource limitation (Anderson & May, 1979). It has been hypothesized that parasitic infections may play a role in the understanding a number of behaviors, including those that have developed as physical, rather than immunological, responses to increased threats of infection encountered by more social animal species (Loehle, 1995). A number of social species, including tadpoles and spiny lobsters, exhibit avoidance behaviors, creating space between healthy and sick individuals in order to decrease infection risk (Kiesecker *et al*, 1999, Behringer *et al*, 2006). Similar avoidance behaviors may be beneficial when applied to shared resources, such as food and water. By shunning resources used by sick conspecifics, healthy individuals can avoid potential sources of infection, as resources shared with sick individuals may contain sources of illness, or allow for the spread of pathogens among neighbors.

Despite the hypothesized fitness benefits gained through resource avoidance, male House Finches have been found to preferentially feed near sick, rather than healthy, neighbors. These behaviors, though, have been attributed to competition, rather than resource selection. When

conspecifics are present, social interactions play a large role in resource use. Male finches are less likely to face social defeats when feeding near sick, rather than healthy individuals (Bouwman & Hawley, 2010). Social defeats can be extremely costly, resulting in a loss in social status and a suppression of the immune response (Hawley, 2006).

The goal of this study was to test whether Zebra Finches would preferentially feed from a food source used by a healthy bird over one they had observed being used by a sick bird. By eliminating social competition, we more directly tested the behavioral reduction of infection risk through selective resource use and avoidance. In order to illicit a sickness response from the experimental birds, one bird from each trial was injected with a lipopolysaccharide (LPS) solution. LPS is commonly used in to induce an immune response in laboratory settings. In Zebra Finches, a response occurs within hours, post-injection (Bertrand, 2006). A range of sickness behaviors may be observed in birds during the 24-hour period following an LPS injection. These behaviors include decreased food and water intake, reduced territorial aggression, and increased amounts of time spent resting (Lopes *et al*, 2012, Owen-Ashley *et al*, 2006).

General Test Procedures:

Housing and Feeding: To test resource use preference, a three-cage apparatus was used. The apparatus consisted of a large focal cage and two smaller observational cages. A divider was placed between the two smaller cages so that the finches in these cages could only interact with the focal bird. One purple and one blue feeder were randomly assigned and placed in the back, outer corner of each of the smaller cages. A white feeder was placed centrally in the back of the focal bird's cage. For each trial, three Zebra Finches were selected based upon uniformity of mass, age, sex, and plumage, and placed at random within the apparatus.

Injection: After a 24-hour acclimation period, one of the observational birds was randomly selected and injected with 2.0 mg/kg lipopolysaccharide (LPS) in 50 μ L phosphate buffered saline (PBS). LPS stimulates sickness behaviors, and the LPS-injected bird served as the "sick" conspecific. The other bird served as the healthy control, and was removed from its cage for an amount of time equal to that of the injected, experimental bird. The control bird was not injected.

Trials: The focal bird was allowed to observe the control and sick conspecifics for a 24-hour period. The focal individual's feeder was removed for two hours prior to video observations in order to ensure feeding motivation. After the two-hour period, both conspecific feeders were moved into the corresponding corners of the focal cage. A divider was placed between the cages and video observation of the focal bird was conducted for the following hour.

Observations: From videos, observations were made every 15 seconds to record whether the bird was present at a feeder, and at which feeder, right or left, at which the bird was observed.

Results:

A total of 26 trials were observed, with 14 trials using all male birds, and 12 using all females. No feeding preferences were found when the total population was analyzed in terms of resource selection between the experimental and control (sick vs. healthy) individuals ($t = .437, p = 0.666$). No further preferences were found among either male ($t = .401, p = .692$) or female ($t = .404, p = .690$) trials (Figure 1).

Further analysis showed that there were no significant effects of feeder color (blue vs. purple) or feeder placement (left vs. right) on feeding behavior by focal individuals.

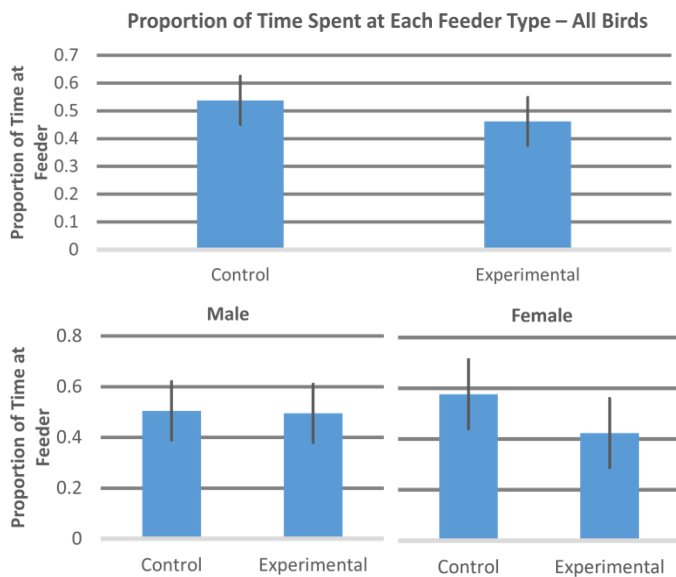


Figure 1: The upper graph shows the mean proportion of time (of time spent at a feeder) spent by focal birds at each feeder type. The lower graphs show the mean proportion of time spent by focal birds at each feeder type, broken down in terms focal bird sex.

Discussion:

When allowed to feed in the absence of costly social competitions, Zebra Finches appear to select resources at random, despite having observed sick conspecifics using these same food resources.

Zebra Finches have high intraspecific interaction, building nests in colonies, and maintaining high sociability (Adkins-Regan, 2002). Species that maintain social lifestyles face higher pathogen risks. They are more susceptible to epidemics and harbor a greater number of pathogen types than less social species (Loehle, 1995). It would seem that Zebra Finches would provide an excellent evolutionary candidate for the development of avoidance behaviors. Nevertheless, there are a number of factors that

may have inhibited the development of these behaviors. One prominent difference between the conditions encountered by finches in a laboratory setting and those found in their native setting is the presence of unlimited food resources. Competition for resources often plays a primary role in the behavior of animals. Resource access, whether or not these same resources have been used by sick individuals, would likely take the forefront in a wild setting, playing a more important role in individual fitness than pathogen avoidance.

Another key difference is that this study relied on the artificial removal of socially mediated competition. These conditions were necessary in order to test the hypothesis, but are unlikely to be realized in a natural setting, especially among highly social birds such as Zebra Finches. It seems more likely that, in situations where choice would be provided, competitive interactions would nearly always play a role in resource use. In a native setting, Zebra Finches face a number of pressures that may inhibit the development of pathogen avoidance behaviors.

These results help to further illuminate previous findings regarding food selection in House Finches (Bouwman & Hawley 2010). The findings of Bouwman and Hawley (2010) suggest that male House Finches, rather than performing a cost-benefit decision between infection-reducing behaviors and costly social interactions, may simply be choosing to avoid social competitions that are more likely to occur when feeding next to a healthier individual.

Further understanding of how sickness behaviors influence resource selection or avoidance could be developed through research regarding Zebra Finch's learned preference, rather than active decision. Researchers Benskin *et al.* (2002) conducted tests regarding social learning in House Finches by using two separate "demonstrator" birds. In their experiment, each demonstrator bird was given two colored feeders, with only one feeder offering food to each of the demonstrator birds (i.e. the left bird could only feed from the white feeder, while the right could only feed from the black). Focal birds were allowed to observe the feeding decisions of the demonstrator birds before being presented with a similar cage setup. Differences were observed in focal bird selection under a number of different conditions, including differences in demonstrator bird sex, band color and familiarity with the focal bird. This study offered an alternative dynamic that revealed how birds learn from individuals perceived to be more familiar or dominant. By extending these same principles to healthy/sick dynamics, it might be possible to reveal an alternative means through which birds might learn to avoid foods that may make them sick. By observing the resource preference of birds that they perceive to be more dominant, individuals may be able to make food selections that are unlikely to risk their own health or status.

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Introduction

Some species alter their behavior when exposed to sick conspecifics. Avoidance behaviors may reduce infection risk by increasing distance between healthy individuals and sick neighbors¹. Similar avoidance behaviors may be beneficial when applied to shared resources, such as food and water. By shunning resources used by sick conspecifics, healthy individuals could avoid a potential source of infection, as resources shared with sick individuals may contain the source of an illness, or allow for the spread of pathogens among neighbors.

Despite these apparent fitness benefits, male house finches preferentially feed near sick, rather than healthy, conspecifics². When conspecifics are present, social interactions may play a large role in resource selection, forcing individuals to choose between infection-reducing behaviors and costly social competitions³. By eliminating social interactions and competition, we more directly tested the behavioral reduction of infection risk through resource use.



Hypothesis

In this study, we tested whether Zebra Finches would prefer food resources they had observed being used by healthy neighbors over those observed being used by sick neighbors. We hypothesized that, in the absence of competition, individuals would choose to feed from feeders used by healthy conspecifics.

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Methods

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Injection: After a 24-hour acclimation period, one of the observational birds was randomly selected and injected with 2.0 mg/kg lipopolysaccharid (LPS) in 50 μ L phosphate buffered saline (PBS). LPS stimulates sickness behaviors and the LPS-injected bird was the "sick" conspecific. The other bird served as the control, and was removed from its cage for an amount of time equal to that of the injected, experimental bird but was not injected.

Trials: The focal bird observed the control and sick conspecifics over a 24 hour period. The focal individual's feeder was removed for two hours prior to video observations in order to ensure feeding motivation. After the two hour period, both conspecific feeders were moved into the corresponding corners of the focal cage. A divider was placed between the cages and video observation of the focal bird was conducted for the following hour.

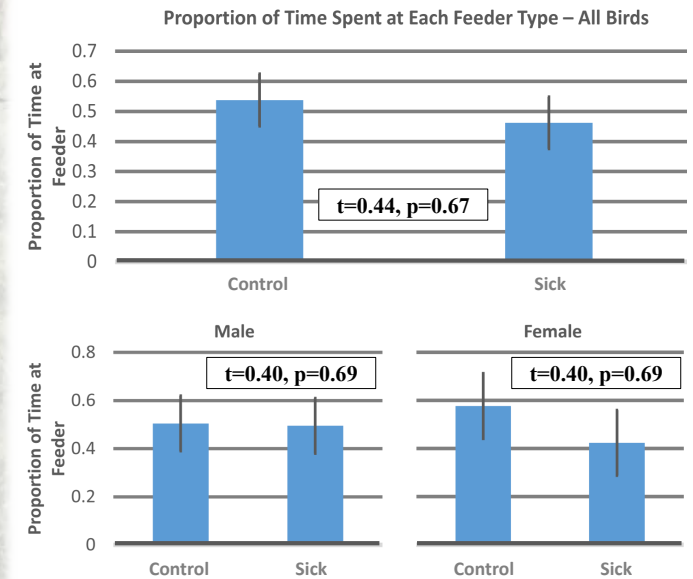
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Results

A total of 26 trials were compared, with 14 trials using male birds, and 12 using females. No feeding preferences were found when the population was analyzed in terms of resource selection between the experimental and control (sick vs. healthy) individuals. There were also no differences between the sexes in feeder selection.

There were no significant effects of feeder color (blue vs. purple) or feeder placement (left vs. right) on feeding behavior by focal individuals (all $p > 0.6$).



Discussion

When allowed to feed in the absence of costly social competitions, zebra finches appear to select resources at random, despite having observed sick conspecifics using these same food resources.

These results help to further illuminate the previous findings of Bouwman and Hawley by showing that male finches, rather than performing a cost-benefit decision between infection-reducing behaviors and costly social interactions, may simply be choosing to avoid social competitions that are more likely to occur when feeding next to a healthy individual.

Literature Cited

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