Responsiveness to heterospecific alarm calls in Thomson's gazelles (*Gazella thomsoni)*

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Introduction

- Eavesdropping, or attention and response to vocalizations of other species, is a learned behavior that is hypothesized to improve fitness[1].
- Responding to heterospecific alarm calls is a common anti-predator strategy among small ungulates[2]. Cuing in on alarm calls from species which have shared common predators is thought to improve survival through early detection of predators[2].
- Studying anti-predator strategies can provide a better understanding of how body size and threat level influence the behaviors and social responses of heterospecific groups.
- We experimentally tested our hypothesis in Thomson's gazelles, a small, gregarious and migratory ungulate with loose social groupings[3].

Hypothesis: Species display stronger behavioral responses to anti-predator alarm calls of larger versus smaller species because predators of larger species should be more dangerous than those of smaller species.

Prediction: Thomson's gazelles will be alert for longer durations and in greater numbers when presented with anti-predator alarm calls from larger ungulates (i.e. topi and impala), rather than alarm calls from smaller ungulates (i.e. Grant's gazelle).

Methods

- We performed playback experiments on a wild population of Thomson's gazelles in the Maasai Mara National Reserve, Kenya.
- We studied 18 groups of Thomson's gazelles with at least 10 topi (*Damaliscus lunatus*), impala (*Aepyceros melampus*), or Grant's gazelles (*Gazella granti*) within 50m of each study group.
- Each group of Thomson's gazelles was observed 10-30 meters away from our vehicle.
- An African dove call served as the control, and the anti-predator alarm call belonged to the particular species that was present near the study group.
- Using a Bluetooth speaker, each alarm call was played twice with five second intervals of silence in between.
- For each trial, focal animal sampling was conducted on two gazelles (one male and one female) and the duration of alert behavior was recorded immediately after the alarm call ended. Alert behavior defined by head up, eyes open, ears forward, frequent flickering of ears, and twitching of tail.
- For each trial, critical incidence sampling was also conducted. The total number of individuals in an alert state were immediately counted after exposure to the alarm call.
- 10 individuals were sampled in each group to control for group size.
- For focal animal sampling we modeled duration of alert behavior as our continuous outcome and number of individuals in an alert state using a one-way ANOVA.

Duration of Alert Behavior of Thomson's Gazelle (s)

Anti-predator Alarm Call	Topi	Impala	Grant's Gazelle
Mean	8.629	5.921	3.488
Standard Deviation	6.951	3.447	5.069

Table 1. Comparison of alert behavioral response of Thomson's gazelles to anti-predator alarm calls.

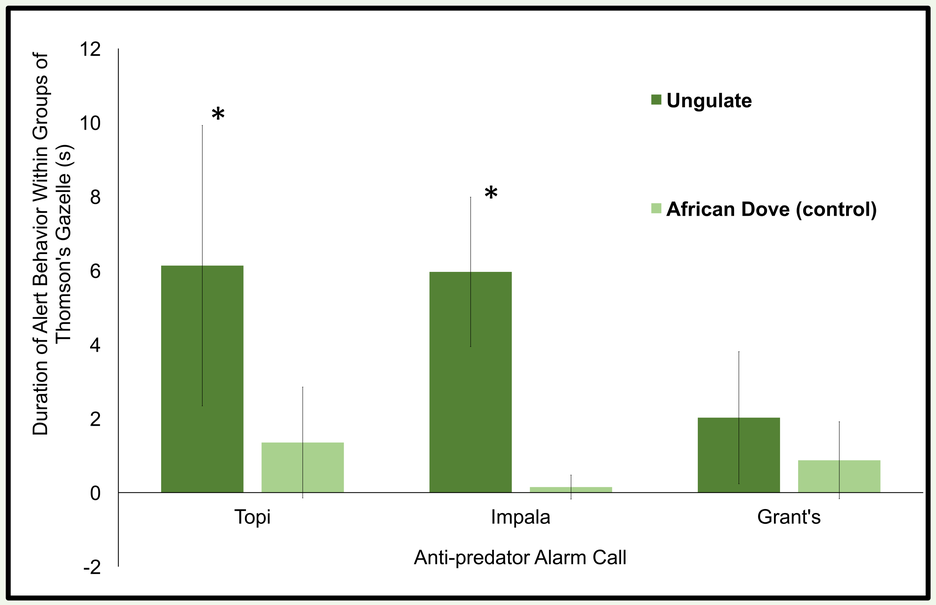


Figure 1. Comparison of alert behavioral response to anti-predator alarm calls and control calls within each group of Thomson's gazelle. Mean +/- 95% confidence intervals shown. Topi (n=7), impala (n=7), Grant's (n=4).

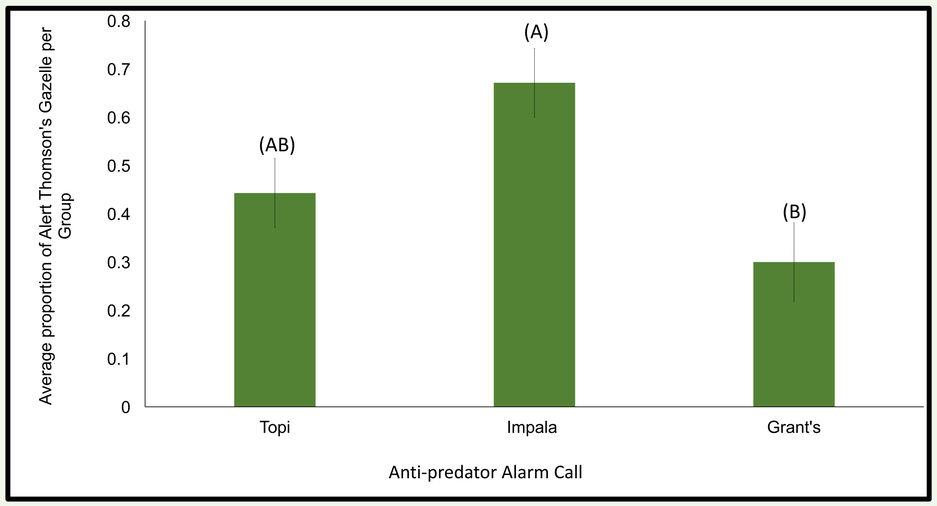
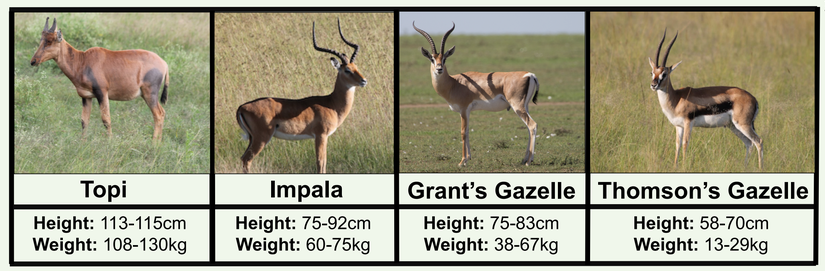


Figure 2. Comparison of the average proportion of individuals displaying alert behavior in each anti-predator call group. Mean +/- 95% confidence interval shown.



Topi	Impala	Grant's Gazelle	Thomson's Gazelle
Height: 113-115cm **Weight:** 108-130kg	**Height:** 75-92cm **Weight:** 60-75kg	**Height:** 75-83cm **Weight:** 38-67kg	**Height:** 58-70cm **Weight:** 13-29kg

Discussion

- We found a declining trend in the average duration of alert behavior corresponding to prey species size, which supports our hypothesis that species respond more strongly to alarm calls of larger prey (**fig. 1 and tbl. 1**).
- We found a significant difference between the anti-predator alarm response and the control response within groups of Thomson's gazelles near topi and impala, showing that the behavioral responses to alarm calls were not due to random chance (**fig. 1**).
- When comparing the average number of alert individuals between each group, we found a significant difference between impala and Grant's calls, but no significant difference between topi and impala calls, or topi and Grant's calls (topi mean=0.4, impala mean=0.7, Grant's mean=0.3; **fig. 2**).
- Figure 3 suggests that anti-predator alarm calls of impala leads to the strongest response in Thomson's gazelle in terms of the average proportion of alert individuals.
- Our hypothesis is only partially supported because we expected the largest ungulate (topi) would lead to the strongest response in Thomson's gazelles.
- The topi alarm call played to focal groups was not as loud and pronounced as the impala alarm call, which may have impacted the responsiveness to the call.

Conclusions

We begin to see a trend in behavioral responses to anti-predator alarm calls: large prey produce a stronger alert response of neighboring species than the call of smaller prey. Species of different sizes can benefit from each other by learning their warning techniques to increase their chances of survival. Prey species can work together to increase their awareness of potential threats, and future studies could look further into eavesdropping behavior to determine if larger prey evoking a stronger alert response of heterospecifics holds true across different prey species or in different ecosystems.

References

1. Palmer M. et al. 2018. Eavesdropping in an Africa large mammal community: antipredator responses vary according to signaler reliability. Animal Behavior. 137:1-9.

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3. Estes R. 1991. The Behavioral Guide to African Mammals. 1st edition. L.A., California University of CA Press.