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Case Study: The pig pheromone androstenone, acting as an interomone, stops dogs from barking

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ABSTRACT

Some dogs display behaviors such as excessive barking and jumping. Unwanted behaviors can often lead to animal abuse or pet relinquishment to a shelter. This study focused on the effects of androstenone on the behavior of dogs showing a barking and jumping syndrome. In the first study, barking dogs were sprayed with (a) nothing, (b) a placebo spray with sound or noise, (c) the same as (b) plus 0.1 μg/mL androstenone in isopropyl alcohol, (d) the same as (b) plus 1.0 μg/mL androstenone in isopropyl alcohol. Dogs were videotaped for 1 min after treatment was applied. Treatments were effective at stopping barking and jumping in 25, 44, 78, and 100% of the barking and jumping dogs, respectively. Videos of the behavioral effects are available for viewing online (see Methods). A second study examined the effects of androstenone on heart rate and behavior while dogs were calm. Four "anxious" dogs were fitted with telemetry jackets and transmitters, heart rate was monitored continually, and cameras recorded behavior. Dog heart-rate data were measured for 10 min before and treatment, 10 min after isopropyl alcohol spray, and 10 min after a spray in the snout with androstenone. Neither androstenone nor isopropyl alcohol changed the heart rate of dogs compared with baseline. The pig pheromone, androstenone, working as an interomone reduced excitable behaviors of dogs. Behavior modification using pheromones can improve animal welfare by reducing the incidence of unwanted barking and jumping behaviors in dogs. Androstenone stops dog excitability through the olfactory system. Androstenone is a pheromone produced by pigs but acts as a powerful interomone in the dog.

Key words: pheromone, interomone, dog, animal behavior

INTRODUCTION

Pheromones were originally defined as "substances secreted to the outside by an individual and received by a second individual of the same species in which they release a specific reaction" (Karlson and Lüscher 1959). Pheromones change the behavior or physiology of the animal that perceives the chemical signal. Androstenone, 5α-androst-16-en-3-one, was the first mammalian pheromone for which the structure was identified (Patterson, 1968). The boar produces androstenone and related steroids in its saliva, which is used as a sexual signal for sows in estrus (Dorries et al., 1995). In addition to its effects on sow reproduction, androstenone reduced swine agonistic behaviors among prepubertal pigs (McGlone and Morrow, 1988).

Some chemical signals operate across species and can either benefit or harm the sender or the receiver. Allomones are chemicals produced that benefit the emitting species (plants) but not the receiving species (certain insects as in Mayer et al., 2008). A kairomone is a chemical produced and released by one species that benefits another species but often causes harm to the emitter (Wyatt, 2003). The term "interomone" is defined as a chemical that operates as a pheromone in a given species but will have a different effect, often unpredictable, on the receiver of another species (McGlone, 2012). An interomone does not have to benefit or negatively affect the sending or receiving species. Because some pheromones such as dog-appeasing pheromone (Ceva Sante Animale, Libourne, France) operate as related

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molecules across species (structurally similar), the interomone concept holds that a pheromone in one species may have a related or different effect in other species.

Excessive barking is a behavioral problem for some dogs and is a common reason people cite for relinquishing their dogs to a shelter (Salman et al., 2000). Barking is associated with a syndrome of vocalizing and jumping termed "mobbing" by Lord et al. (2009). The barking–jumping–mobbing syndrome is often considered a behavioral problem among dog owners.

In this study, androstenone was used as a putative interomone to affect dog barking. Androstenone was initially observed to have a calming effect on dogs. Our objective was to determine whether androstenone reduced barking and jumping behaviors in excitable dogs.

MATERIALS AND METHODS

All dogs were mixed breeds and various ages; dogs were selected because they demonstrated excessive excitability in the form of barking and jumping. Dogs were housed individually in chain-link, kennel runs. A handler walked a quiet, well-trained test dog (Labrador mix) in front of the runs and then stopped while the test dog sat quietly in the aisle. This action caused some dogs to bark and jump in an excitable manner inside their kennel.

Thirty-six dogs with barking and jumping syndrome were examined. These dogs were excitable especially when a human or other dog was near. Timing and video recording started when the experimenter walked to the front of the dog kennel and sat the teaser dog in the aisle. Some dogs stopped barking and jumping with no treatment applied ("nothing"). The experimenter then randomly applied one of the following treatments in random order: (1) nothing, n = 12; (2) loud spray (approximately 110 dB) with spray of compressed air in a 1-s blast, n = 9; (3) 0.l μg/mL 5α-androst-16-en-3-one (Sigma-Aldrich Co. LLC, St. Louis, MO) in isopropyl alcohol ("dilute andro") with noise, n = 9; or (4) 1.0 μg/mL 5α-androst-16-en-3-one ("full-strength andro") with noise, n = 6. Dog behavior was videotaped for 60 s after treatment. Example videotapes are available online for review (http://www.depts.ttu.edu/animalwelfare/Research/Pheromones/Dog.php). Data analysis for the efficacy of androstenone and loud spray was performed using chi-squared comparing the control (nothing), loud noise alone, and each concentration of androstenone.

There were concerns that androstenone may cause a negative, fearful behavior in dogs. Therefore, another study was conducted to determine whether heart rate changed after dogs were sprayed with androstenone. Four "anxious" dogs (diagnosis confirmed by a diplomate of the American College of Veterinary Behaviorists; Dr. Valerie Tynes) were fitted with telemetry jackets and transmitters (DSI, St. Paul, MN) so that heart rate could be monitored continuously. Heart rate data were collected for 10 min before treatment, 10 min after isopropyl alcohol spray (control), and 10 min after a spray in the snout with androstenone (1 μg/mL) in isopropyl alcohol as a vehicle. The application of androstenone included a noise as in the previous study. Heart rates were sampled each second during the test periods.

Data were subjected to ANOVA. Treatment effects in the model included effect of dog and treatment (before, isopropyl alcohol control, and androstenone at 1 μg/mL).

RESULTS AND DISCUSSION

When the experimenter stood in front of the kennel of a barking and jumping dog, 25% of the dogs (3 out of 12) stopped barking (Figure 1). When the loud noise alone was applied, 44% of the dogs (4 out of 9) stopped the barking and jumping for at least 60 s (differed from control of nothing, $\chi^2 = 3.91$; $P < 0.05$). When androstenone was tested at 0.1 μg/mL, 78% of dogs (7 out of 9) stopped barking and jumping ($\chi^2 = 18.6$; $P < 0.001$ compared with nothing; $\chi^2 = 5.95$; $P < 0.05$ compared with the loud spray alone). When the greater concentration of androstenone (1.0 μg/mL) was sprayed, 100% of dogs (6 out of 6) stopped barking and jumping ($\chi^2 = 29.25$ compared with nothing, $P < 0.001$; $\chi^2 = 13.0$ compared with the loud spray, $P < 0.001$, and not different from the lesser concentration of androstenone). The R^2 over the increasing treatments was linear with a value of 0.99 (Figure 1). Videos of dog responses may be observed online (see Methods). Most dogs licked their lips and nose, sniffed their environment, and sat or lay down after experiencing androstenone.

Because dog behavior abruptly stopped with androstenone, we wondered if the dogs might be experiencing startle-induced heart-rate increase. Neither isopropyl alcohol nor androstenone had an effect on the heart rate of dogs (Figure 2). Androstenone did not change dog heart rate during the 10 min after spray compared with the same period before spraying. These test subjects were clinically anxious dogs, and so any effect on these animals may be expected to be exaggerated compared with clinically nonanxious dogs. At any rate, the androstenone did not cause an elevation (or reduction) in heart rates.

The barking–jumping–mobbing syndrome is an undesirable behavior among dogs in many settings (it may be desirable in other settings such as a watch dog meant to deter people). Because this syndrome is undesirable to many people, it is a major cause of giving up dogs to a shelter (Salman et al., 2000). Any method that can reduce the barking–jumping–mobbing syndrome without creating a new animal-welfare issue (i.e., pain from shock collars or striking a dog) would be desirable.

This study work employed 2 control treatments. One was to do nothing other than stand in front of the dog kennel. Doing nothing stopped 25% of the dogs from barking and jumping. When noise alone was used, 44% of