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Partner preference: Assessing the role of the female goat

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ABSTRACT

For domestic ruminants, the male is thought to have the control over mate choice. The aim of this study was to assess the potential role the female goat plays in choosing a sexual partner. Approach frequency and proximity time to various social or sexual stimuli in a Y-maze apparatus were used as partner preference assessment parameters. Ovariectomized females were either induced into estrus ($n=8$) or induced into anestrus ($n=8$) and exposed to various goal stimuli — intact unfamiliar females (estrous and diestrous), intact males, and neutral (empty) in six separate trials. Total arm entries and time spent within one body length of the goal (proximity time — used to calculate preference scores) were recorded for subjects. With a male present, anestrous subjects had significantly more total arm entries than estrous subjects. Estrous subjects showed a significant preference for the male goal (M) versus the estrous female (ES), diestrous female (DS), and empty goals, respectively. Estrous subjects also showed a preference for the ES and DS goals when one goal was left empty. Anestrous subjects showed a preference for the goal containing ES, DS, and M compared to empty goals. They also showed a preference for ES vs. DS. The Y-maze is a tool that can be used to assess sexual and social partner preferences in female goats. The role the female plays in choosing a partner may be much greater than previously considered.

1. Introduction

Female sexual behavior fluctuates across the estrous cycle in a number of species and is caused by cyclic variations in estrogen and progesterone secretion from the ovaries [1]. Behavior plays a crucial role in whether or not one can attract a mate and reproduce successfully. Partner preference is an adaptive aspect of sexual behavior that helps to ensure successful mating and is an essential component of sexual behavior [2]. Studies to assess partner preference have been conducted in an array of animal models including rats, ferrets, mice, and zebra finches [2–5].

It is generally accepted that partner preference is sexually dimorphic, such that sexually experienced male animals prefer (spend more time and interact more with) estrous females, while estrous females prefer a sexually active male [2]. When given a choice between an estrous female and a sexually active male, sexually active male rats, as well as sexually receptive female rats, exhibit a heterosexual preference. When given a choice between two females, studies show that normal male rats prefer estrous female rats (either sexually intact or ovariectomized and then primed with estrogen/progesterone) over non-estrous (either ovariectomized or sexually intact during a non-estrous stage of the estrous cycle) female rats [6,7].

In an array of species, various experimental designs have been utilized to evaluate the appetitive aspects of female sexual behavior. Assorted types of mazes (T-mazes, Y-mazes, radial arm mazes, water mazes, etc.) have been used as tools to help decipher how different treatments or conditions affect learning, memory, and choice behaviors. Traditionally, rats, mice, and ferrets have been employed as test subjects in maze studies. One way to evaluate partner preference of the female test subject is to record the time she spends in proximity to a variety of stimuli (intact male, castrated male, sexually receptive female, empty compartment, etc.). Measures of partner preference can differ noticeably among varied test conditions [8]. Hormonal status and prior sexual experience have been thought to be two other factors that can affect partner preference [9]. It has been suggested that preference for a sexually appropriate partner is a good measure of sexual motivation [10,11].

In the wild, goats live in sexually segregated flocks, except in geographical areas where breeding occurs year-round. The females typically live in small, stable groups and during the breeding season, males join the female groups and compete for access to the females [12]. The males typically perform pre-copulatory behaviors towards the female which include foreleg kicking, body and ano-genital sniffing, and other courting behaviors [13]. Since males approach estrous females, it seems as if the male gets to determine with whom he copulates. However, females also exhibit a variety of behaviors that suggest they likely play a key role in choosing their mating partners. In light of this, the current study was designed to assess the female goat's role in choosing sexual partners. It was hypothesized that estrous

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females would prefer to approach and remain in the vicinity of a sexually active male as compared to a sexually indifferent partner or neutral stimulus demonstrating that the role the female plays in choosing a sexually appropriate partner may be greater than previously considered.

2. Materials and methods

2.1. Experimental animals

The research protocol was approved by the Rutgers University Animal Care and Facilities Committee. The female subjects ($n=8$) were ovariectomized French-Alpine females between the ages of 4 and 11 years. Five intact French-Alpine females (all 3 years of age) and four intact French-Alpine males (3–5 years of age) served as sexual/social goal animals for the female subjects. The female subjects were housed at the same barn as the male goal animals, but in non-adjacent pens which prevented interaction between the groups. The female goal animals were housed in a separate barn.

2.2. Hormones for induction of estrus

Ovariectomized female subjects were induced into estrus using a sequential treatment of progesterone and estradiol, according to the protocol developed by Billings and Katz [14]. Anestrous control subjects were treated with progesterone followed by benzyl benzoate dissolved in oil (vehicle for the estradiol). Intact goal females were treated with prostaglandin F2α (PGF2α) to induce estrus during October–February (breeding season). From March–May (non-breeding season), intact goal females received a supplemental injection of estradiol after PGF2α treatment to induce estrus (unpublished protocol).

2.3. Partner preference testing

All animals included in the study were acclimated to the Y-maze (Fig. 1) for six weeks prior to testing. Trials commenced once all stimulus animals showed no signs of stress while in the goal box and all subject females traversed the maze at will.

One designated goal box animal was placed in each of the two goal boxes (or goal box left empty) for each trial and stayed there for the duration of the trial (15 min). One subject female at a time was guided to the start box and placed inside. The female was then released from the start box and was allowed to traverse the maze for 15 min. Once the subject was released, the door which separated the start box from the rest of the Y-maze was closed in order to prevent re-entrance to the start box. The parameters recorded during each test included frequency of arm entries and proximity time — time spent within one body length of the goal box (used to calculate preference scores).

Each trial was conducted over a two-week time period. Subject females who had been in estrus for the first week were anestrus the second week and vice versa. Thus, for each trial condition, each female was tested twice, once while in estrus and once while anestrus. Also, the goal box animals were placed in opposite goal boxes from the prior week.

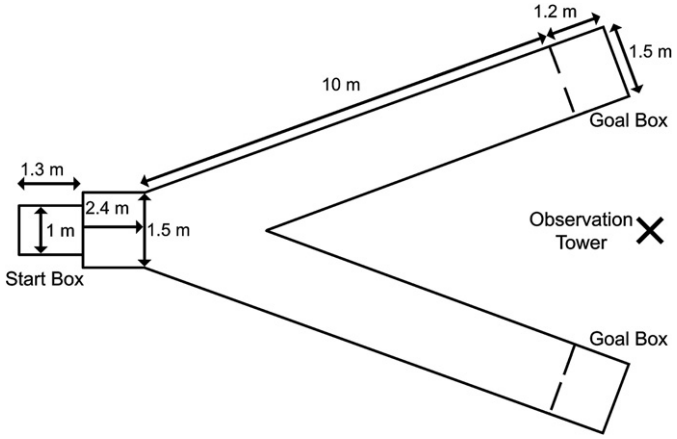

Fig. 1. The Y-maze testing apparatus (not drawn to scale) for partner preference testing. The above figure illustrates the layout of the study area and includes dimensions. The Y-maze was constructed of plywood and consisted of two arms, a completely closed start box, and two goal boxes. The start box was placed behind the branch point of the Y. Solid, wooden doors were located at both ends of the goal boxes. A wire partition was placed on the opposite side of each goal box allowing for olfactory, auditory, and visual interactions between the subject and goal animals. An observation tower (2 M high) was positioned between the two arms which allowed all angles to be visible during testing.

2.4. Statistical analysis

A one-way ANOVA was used to determine any differences in total arm entries between treatments (estrus vs. anestrus). Preference scores (%) were calculated for each subject in each trial with the following formula:

$$Preference\,Score = \left(\frac{proximity\,time\,spent\,near\,one\,goal\,box}{proximity\,time\,spent\,near\,both\,goal\,boxes}\right) \times 100$$

Preference scores were determined to be different from chance (50%) using a binomial test. Variation in preference scores is reported as standard error of the proportion ($\pm$SEP). Results were deemed significant when $P<0.05$. (NCSS Statistical Software, 2001, Kaysville, UT).

3. Results

3.1. Total arm entries

The mean frequencies of total arm entries for subjects in each trial are presented in Table 1. For the trials in which a male was present in the goal box, anestrous subjects made significantly more total arm entries than estrous subjects. When no male was present, there were no differences in the number of arm entries made between the two subject groups.

3.2. Preference scores

The mean preference scores for each trial are presented in Fig. 2 (male present in goal, or empty goal) and Fig. 3 (female present in goal, or empty goal). Estrous subject females demonstrated a highly significant preference for a male in the goal as compared to a diestrous female, an estrous female, or an empty goal (Fig. 2). With a male present, estrous females spent far more time near the male versus other goal choices. Estrous subjects also showed a preference for the ES and DS goals when one goal was left empty (Figs. 2 and 3). Anestrous subjects showed a preference for the goal containing ES, DS,

Table 1
Mean ($\pm$SEM) total arm entries performed by the subject animals during the 15-min partner preference testing period for each trial. *Denotes significance ($P<0.05$) between reproductive states (estrus vs. anestrus).

Goal box choices	Total arm entries	
	Estrus subjects	Anestrus subjects
Estrous female (ES) vs. Diestrous female (DS)	11.3 ± 2.1	11.5 ± 2.0
DS vs. Male (M)	4.1 ± 0.9	9.3 ± 1.5*
ES vs. M	6.3 ± 1.8	13.5 ± 2.0*
ES vs. Empty Goal (EMPTY)	11.0 ± 2.5	10.8 ± 1.7
DS vs. EMPTY	10.4 ± 3.1	11.0 ± 2.4
M vs. EMPTY	3.4 ± 0.9	10.0 ± 1.4*