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The role of vaginal stimulation for the acquisition of conditioned place preference in female Syrian hamsters

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Abstract

This study investigated the importance of vaginal stimulation on conditioned place preference by sexual behavior in female Syrian hamsters. Hormonally primed female hamsters given vaginal masks and topical lidocaine prior to conditioning sessions were no different in their place preference conditioning compared to female controls with no vaginal mask or lidocaine. Control females not provided a sexually active male did not show any preference for either compartment of the conditioning apparatus. These results suggest that stimuli, in addition to vaginal stimulation, are effective in producing a place preference during the mating experience in female hamsters.

Keywords: Conditioned place preference; Lordosis; Vaginal stimulation; Sexual behavior

1. Introduction

Numerous studies have provided clear evidence that sex is as much an incentive as food or drink. In the earliest studies, intact males and receptive females were willing to transverse an electrified grid when the possibility to copulate with a member of the opposite sex was used as an incentive [1]. A number of other methodologies have been used to assess the incentive properties of reproductive behaviors in males and females. These include the runway procedure [2,3], lever pressing [4,5], and conditioned place preference [6–10]. In the conditioned place preference paradigm, the amount of time an animal spends in one compartment of a multicompartment chamber will increase after continual exposure to a reinforcing stimulus even in the subsequent absence of the reinforcer [11].

Examination of the rewarding properties of sexual behavior in female rodents has demonstrated acquisition of a conditioned place preference following sexual interactions with a male [6–9,12–14]. This conditioning is robust in hamsters [6] and can also be robust in rats if the female rat is given the opportunity to control or pace the timing of intromissions from the male [9,12–14].

Dopamine release in the nucleus accumbens is thought to mediate the reinforcing components of food, drugs of abuse, and sexual behavior [15–17]. The rewarding components of female sexual behavior in rodents have been shown to depend on dopaminergic activation of ventral striatal neurons, most notably in the nucleus accumbens [18–22]. This dopaminergic activation in the nucleus accumbens may support place preference acquisition because raclopride, a dopamine (D_2) receptor antagonist, has been shown to disrupt place preference attainment without disrupting the expression of sexual behavior [7]. The genital stimulation in females that accompanies penile intromissions from the male has also been shown to activate dopaminergic neurons in various brain regions [23–27]. Significant changes in dopamine levels are not seen in sexually receptive females that are prevented from receiving vaginal stimulation [25]. These observations suggest that vaginal stimulation may be

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a critical reward component for the female and also may contribute to the acquisition of a conditioned place preference. Thus, the present study examined the importance of vaginal stimulation received from the male during mating for the acquisition of conditioned place preference in female hamsters.

2. Method

2.1. Subjects

Subjects in this study were 22 adult female Syrian hamsters (Charles River Breeding Laboratories) about 55 days old at the time of arrival. Adult male Syrian hamsters served as stimulus animals for lordosis behavior tests. Experimental females were housed individually and males were housed in groups of three to four in plastic cages (25.5×40×20 cm), in a colony room maintained at 22 °C on a 14:10-h light cycle with lights out at 1130 h. Food and water were freely accessible, except during behavioral testing.

2.2. Apparatus

The design of the conditioned place preference apparatus was described previously [6]. Two compartments (60×45×38 cm), one white and one gray, were connected by a clear central compartment (37×22×38 cm). In order to isolate the females during conditioning, sliding partitions of the same color as the compartments were used. To further distinguish the compartments, the gray chamber had pine shavings (the same bedding as in the females' home cages) and the white compartment contained bed-o'cobs (1/4 in.) bedding.

2.3. Conditioning and testing procedures

Generally, the conditioning and testing procedures used in this study followed previously accepted methods for the conditioning of hamsters [6,7]. Approximately 1 week following arrival, females were bilaterally ovariectomized while anesthetized with ketamine/acepromazine (150 mg/kg+5 mg/kg b.wt. i.p.). One week after surgery, females were injected s.c. with 10 μg of estradiol benzoate (in 0.1 ml cottonseed oil) followed 2 days later by an s.c. injection of 500 μg of progesterone (in 0.1 ml cottonseed oil). This regimen is sufficient to induce lordosis in females if paired with a male. Hormonally primed females were given three weekly preference pre-tests, which consisted of placing each female in the central chamber of the apparatus and allowing her to roam freely between the gray and white compartments for 15 min. The amount of time spent individually in the gray and white compartments was recorded.

The hormone regimen given prior to the initial preference tests was repeated weekly for the subsequent 5 weeks of conditioning. Immediately prior to conditioning, eight females had their vaginal area swabbed with topical lidocaine and tape placed over the vaginal opening. Eight other females received no mask or lidocaine. All 16 females were then individually placed in the gray compartment of the apparatus with a sexually experienced male hamster for 15 min. About 1 h later, the females were placed in the white chamber for 15 min. Additional control animals consisted of three females with vaginal tape and topical lidocaine and three without a mask or lidocaine. These six females were placed in the gray compartment for 15 min without a male and then 1 h later in the white chamber for 15 min. During the conditioning sessions of females with a male, the total time the females held the lordosis posture was recorded. The number of mounts, intromissions, and ejaculations of the males was also noted. Mounts and intromissions were scored by observing the gross motor patterns displayed by the male as described elsewhere [28].

The week following the last conditioning session, females again were hormonally primed and then given a preference post-test. As with the pre-test, the females were placed in the central compartment and allowed to roam freely between the two chambers for 15 min, and the total time spent in the white and gray compartments was recorded. All behavioral testing was conducted in a room with ambient fluorescent illumination within 4 h of the onset of the dark portion of the daily cycle in the colony room and 4–6 h following the administration of the progesterone in the hormone priming regimen.

3. Results

As expected (see Fig. 1), the copulating females without vaginal masks spent significantly more time in the gray side (A), where mating occurred during the posttest (t_7=4.15, p<0.005) and a corresponding decrease in time in the unpaired white side (B) (t_7=3.65, p<0.009). Surprisingly, the copulating females with vaginal masks also spent significantly more time in the gray compartment (A) (t_7=3.93, p<0.006) with a corresponding decrease in time in the unpaired white side (B) (t_7=3.84, p<0.007). The females in the two control groups did not show a change in compartment preference between the pretest and posttest for either the gray (A) or white (B) sides, either as masked vs. non-masked or combined into one group as shown in Fig. 1. Females with or without vaginal masks showed high levels of lordosis with an average lordosis duration of 8.2 and 8 min, respectively, of the 15-min interaction with the male. Thus there were no significant differences in lordosis duration between the two copulating groups as is evident in Fig. 2.

Table 1 summaries the copulatory stimuli received by the females with and without vaginal masks from the male. As expected, the number of intromissions that the