INSTRUMENTS & TECHNIQUES

An automated apparatus for the assessment of social preferences in rodents

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Preference apparatuses offer a straightforward method for the assessment of social preference in a controlled manner. The present paper provides the information necessary for the construction of an automated preference apparatus for rodents and a demonstration of the operation of this apparatus. In a representative study, *Peromyscus polionotus* females demonstrated preference for intact over castrated males.

Ideally, social behavior and social preference should be studied in natural settings. Although this approach may be utilized successfully with diurnal and highly visible species, it is often an impractical or nearly impossible approach for many species. As an alternative, investigators have often turned to the study of populations in outdoor (Ågren, 1976; Boice, 1977; Boice & Adams, 1980; Gipps & Jewell, 1979; Jannett, 1980; Lidicker, 1980) and indoor (Bowen & Brooks, 1978; Crowcroft & Rowe, 1963; Getz & Carter, 1980; Hill, 1977; Poole & Morgan, 1976; Reimar & Petras, 1967; Thiessen & Maxwell, 1979; Thomas & Birney, 1979) seminatural enclosures. Although these enclosures may approximate some aspects of the natural setting and allow a degree of control over experimental variables that is generally not available in nature, individual interactions may at times be so complex that it is difficult to evaluate the effects of any single factor on the behavioral patterns of interest. This problem has often led investigators to use more controlled situations, such as those provided by preference apparatuses, to evaluate the role of various factors in social preference (Ågren & Meyerson, 1977, 1978; Carr, Wylie, & Loeb, 1970; Halpin, 1978; Huck & Banks, 1982; Mainardi, Marsan, & Pasquali, 1965; Martin, 1977; McDonald & Forslund, 1978; Ruddy, 1980; Webster, Sawrey, Williams, & Dewsbury, 1982; Webster, Williams, & Dewsbury, 1982). An automated apparatus for the study of rodent social preference is described in the present paper.

The discrimination of sexually intact from castrated males by females represents the type of choice behavior that may be studied using preference apparatus. The ability to select sexually nonimpaired males should be

adaptive to females and has, among other species, previously been demonstrated in laboratory rats (Carr, Loeb, & Dissinger, 1965; Carr et al., 1970; Gilman & Westbrook, 1978), hamsters (Johnston, 1979; Landauer, Banks, & Carter, 1977), house mice (Scott & Pfaff, 1970), and montane voles (Webster, Williams, & Dewsbury, 1982).

METHOD

Apparatus

The apparatus is of a size appropriate for studies with mice. The unit is a three-chambered rectangular box with a hinged lid; it is constructed of .25-in. (.6-cm) Plexiglas and measures 44 x 21.5 x 20 cm (Figure 1). The inside measurements of the two end areas are 10 x 21.5 x 20 cm. These chambers are open to the middle area through 7 x 7 cm openings centered at the bottoms of the partitions and the middle areas. A stimulus box with a hinged lid (inside measurements of 8 x 7 x 8 cm) is attached to

Figure 1. Preference apparatus.

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each end chamber, and is open to it through a 6 x 5 cm opening. The end chambers are also designed to accommodate small removable "choice chambers" that measure 10 x 8 x 6 cm. Choice chambers are held in place by means of small Plexiglas cubes cemented to the bottoms of the end chambers. When a choice chamber is placed in an end chamber, one end of the choice chamber is accessible from the central area; the other end is open to the stimulus box. A hardware-cloth screen is installed in the opening to the stimulus box. As in the study to be described, a second piece of hardware cloth may be fitted to the inside of the stimulus box to provide a double screen between the choice chamber and the stimulus box. The start box, attached to the back side of the middle area, is constructed by modifying a stimulus box to accommodate a guillotine door.

A bank of three red-sensitive photocells (Clairex, Type VT-311L, peak response at 735 nm) wired in series behind each choice chamber, detects entries to the chamber. The light sources for the photocells are 60-W red light bulbs placed 27 cm in front of the apparatus opposite each bank of photocells. Each photocell is attached to the end of a tubular 4.3-cm piece cut from a 12 x 75 cm disposable plastic culture tube. The out-sides of these tubes are painted black; this, in effect, increases the sensitivity of the photocells to objects directly in front of them by columnating the light to them. The lower .6 cm of the outer walls of the choice chamber are painted flat black to reduce glare from the floor to the photocells. The photocells are situated behind the half of the choice chamber closest to the stimulus box. They are located such that, in order to register a visit to the chamber, an animal has to be completely inside the chamber, and at least partially in the half of the chamber closest to the stimulus animal. In order to prevent animals from rearing over the light entering the photocells, and thus escaping detection during some visits, an additional piece of Plexiglas is inserted into the choice chambers. This Plexiglas extends down from the center of the ceiling to the top of the mesh-covered opening to the stimulus box (see Figure 2).

The diagram in Figure 3 illustrates the circuits for one choice chamber. Each bank of photocells is wired in series with the coil of a 10,000-ohm, 24 V dc DPDT relay (Electronic Specialty Company Model 416B8-3-DW). The relay, in series with any bank of photocells, remains energized as long as all

Figure 2. (a) Start box, (b) choice chamber, and (c) photo-cell assembly.

Figure 3. Diagram of the preference apparatus.

three photocells are illuminated; when the light falling on any one of the photocells is blocked, the relay returns to an unenergized condition. The relays are powered through a variable power supply set for a continuous output of 26 V. One of the normally closed contacts of each of the 10,000-ohm relays is wired into a pen circuit of an Esterline-Angus operations recorder, to provide a permanent record of entries into each choice chamber. The other normally closed contact controls a second set of DPDT relays (BRS/LVE Model 231-12) mounted on a relay rack along with two banks of Sodeco counters.¹ The first bank of counters is wired in series through one of the normally open contacts of the second set of relays to a bank of pulse formers (Scientific Prototype Model 4169JP). The pulse formers provide a controlled duration input to the visits counters. This prevents damage to the counters and ensures that they are advanced only once per visit. The second bank of counters is operated by the output from a recycling timer (Scientific Prototype Model 901) through another normally open contact of the second set of relays. A single recycling timer, set to produce pulses every 1/3 sec, is used for all stations. The continuous stream of pulses from the recycling timer is switched through the second, normally open contact to the relays to the appropriate counters, which record the total duration of visits to the nearest 1/3 sec. Session duration is automatically controlled via another timer (BRS/LVE Model 253-21, not displayed), which regulates the input to the recycling timer and the counters.

Subjects

The subjects were 28 male and 14 female old-field mice, *Peromyscus polionotus*, between 80 and 100 days old. The animals were maintained in litters until 4 weeks prior to the preference tests. At that time, the mice were assigned to groups consisting of 2 males and 1 female, with the constraint that none of the individuals in a group were related (no common grandparents). All animals were individually housed in the colony room under a 16-h-light:8-h-dark photoperiod; food and water were available ad lib.

Procedure

One male of each group was gonadectomized under ether anesthesia; the other male received a sham operation. Four weeks later, the males were confined to the stimulus boxes of the preference apparatus for 1-h adaptation to the apparatus. Females for each group were confined to the start box of the preference apparatus for 5 min, after which they roamed free in the apparatus, with no other animals present. Preference tests were conducted on the following day.

For preference tests, the castrated male from a group was confined to the stimulus box at one end of the apparatus, and the intact male was confined to the stimulus box at the opposite

end. Males were placed in the stimulus boxes 15 min prior to the start of a test. Five minutes prior to the start of the test, the female of the group was placed in the start box. Tests were begun by raising the door to the start box and allowing the female to approach the two stimulus animals. The number and durations of visits to each side were recorded, as previously described, for 1 h.

RESULTS

The results of the preference tests are presented in Table 1. Although intact males were not visited more frequently than castrated males, females spent significantly more time with the intact males, and a significantly larger number of females exhibited longer durations with intact than with castrated males (sign test: $N = 14$, $x = 2$, $p < .01$). Females made virtually equal numbers of visits to both types of males, indicating that they sampled both males, presumably assessing some stimulus characteristic, rather than remaining near the first male encountered.

DISCUSSION

Although the study of social preference can most meaningfully be conducted under natural conditions, the complexity inherent in those same conditions may often complicate examination of the factors of importance in preference behavior. The use of a preference apparatus, such as the one described, offers a straightforward method for assessing social preference in rodents under more controlled conditions. In the study presented in this paper, in which female *P. polionotus* displayed preference for intact over castrated males, we demonstrated that the apparatus described can be used effectively to provide data on choice behavior in rodents.

The use of an automated apparatus considerably simplifies the collection of data on preference behavior, allows studies to be completed more quickly, and allows durations of visits to stimulus animals to be recorded more accurately than can be done with manual recording. Although it is advisable that the experimenter gain familiarity with the behavior of his or her animals in the preference apparatus, it is not necessary that he or she be present during all experimental sessions. In addition to allowing longer continuous records, this allows the experimenter to conduct more than one study simultaneously.

Table 1
Duration and Number of Visits by Females to
Intact and Castrated Males

Visits	Castrated Male		Intact Male		Paired t Test
	Mean	SE	Mean	SE	
Number	173.5	63.0	179.5	54.1	.19
Total Duration	372.1	81.6	845.1	220.1	1.87*

* $p < .05$.

The use of a preference apparatus should be viewed as a complement to naturalistic observations, rather than as a substitute. The preference apparatus may be used to screen factors of interest before more intensive study under natural or seminatural conditions, or as a means of more closely examining factors observed under more naturalistic settings. A fruitful approach to determining factors of importance in social preference, for example, might involve recording choice based on particular factors in the preference apparatus in conjunction with study of the same factors under seminatural or natural conditions. It would be particularly useful if the same individuals could be studied in both the preference apparatus and in a more natural setting, because the behavior of a particular individual under both sets of conditions could then be compared.

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NOTE

1. The relay rack and equipment were electrically isolated from the photocells and 10,000-ohm relays and were driven by a separate 28-V dc power supply. Although not necessary, this step was taken to facilitate use of the recorder in isolation from the relay rack. The two systems were connected via a plug along the circuit from the top power supply and the upper relay coil via the NC contacts of the lower relay (see Figure 3). The system may be modified to require only one power supply by eliminating the bottom supply in Figure 3 and simply connecting the outputs.

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