Sexual satiety in rats: Effects of prolonged post-ejaculatory intervals¹

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Two experiments were conducted in order to determine the effect of enforcing 1 h rest periods between the fourth and fifth ejaculatory series on the number of ejaculations to satiety in male rats—with and without changes of female. Where differences were observed they were in the direction of decreased ejaculation frequencies following prolonged intervals. Such effects may be due to the female. The data were interpreted as suggesting that sexual satiety is not solely an effect of general fatigue.

Examination of the factors governing the initiation, regulation, and termination of a behavior pattern is essential for a full understanding of the determinants of the pattern. In the case of the study of copulatory behavior, there is a particular paucity of data regarding the factors controlling the termination of the behavior or sexual satiety.

The normal copulatory pattern of rats consists of bouts or series of vaginal intromissions with each series terminated by an ejaculation and separated from the next series by a refractory period or Post-Ejaculatory Interval (PEI). Typically, a mean of about seven ejaculations occur before a satiety criterion (e.g., $\frac{1}{2}$ h without an intromission) is reached.

Satiety represents an important process about which more data are needed if it is to be understood. One kind of data that would be important to such an understanding would consider the degree to which satiety is a time-dependent process. Studies enforcing prolonged rest periods both within and between series of copulations have provided important information about the regulation of copulatory behavior (e.g., Beach & Whalen, 1959a; Beach & Whalen, 1959b). It is reasonable that analogous manipulations might yield data which could be important in understanding the satiety process.

Such data should also provide information useful in deciding between the two alternative classes of models regarding the development of sexual satiety. One class of model treats satiety solely as a function of non-specific fatigue (Beach & Whalen, 1959a). The second class treats satiety as the results of changes in some controlling mechanism specific to sexual activity (Beach, 1956; Seward, 1956; McGill, 1965). In the former view prolonged PEIs must be regarded as rest periods during which fatigue should dissipate. With fatigue partially dissipated, the amount of copulatory activity prior to satiety should be increased.

As a by-product of this work it will also be possible to examine the effects of a long enforced PEI on the next series late in a test in order to determine whether prolonged PEIs late in tests have the same effects as those early in tests. The only study to enforce prolonged PEIs later than the first PEI (Larsson, 1959) used comparatively short intervals. Similarities or differences in the "Enforced PEI effect" would be interesting in view of the changes in behavior that occur as the test progresses (Beach & Jordan, 1956; Dewsbury, 1968).

In the present experiments intervals of 1 h were enforced immediately after the fourth ejaculatory series. This was in order to place an appreciable interval as late as possible in the test so that fatigue would have developed prior to the interval. The fourth PEI was regarded as the latest point beyond which nearly all rats might be expected to continue.

EXPERIMENT 1

Subjects

The Ss were 10 male Simonson Long-Evans rats 172 days of age and with considerable copulatory experience at the beginning of testing. They were mated with a group of females of the same age and experience.

Apparatus

All tests were conducted in four Plexiglas observation cages which were 32 in. in diameter and 26 in. high. Cages were placed on wooden bases which were covered with a commercially-produced litter. All events were recorded manually on an Easterline-Angus operations recorder.

Procedure

Each male received two tests of copulatory behavior spaced two weeks apart. These were conducted during the early part of the dark phase of a reversed 12-12 light-dark cycle. Five min after the male was placed in the test cage the female was introduced and the test begun. Testing was continued to a satiety criterion of 30 min with no intromissions or 2 h since the last ejaculation. On one test for each male the female was removed for a period of 1 h following the fourth ejaculation. On the other test for each male the female was removed and immediately replaced. This was to control for nonspecific effects of handling the female. Half of the rats received each test first with assignment of rats to running order random. Four rats were tested simultaneously.

Females were given intra-muscular injections of 0.1 mg estradiol benzoate 72 h before testing and 1.0 mg progesterone 3 h before testing. Only receptive females were used in tests.

The following measures will be considered: Ejaculation Frequency (EF)—the number of ejaculations to satiety; Ejaculation Latency (EL)—latency from the first intromission to the ejaculation in each series; Intromission Frequency (IF)—the number of intromission in a series; Mean Inter-Intromission Interval (MIH)—the mean interval separating the intromissions in a series; the First Inter-Intromission Interval (III₁)—first III of a series.

Results

The results of Experiment 1 are summarized in Table 1. The most important finding is that enforcing a 1 h interval between the fourth and fifth series produced a significant decrease in EF.

In addition to this change, several effects of the prolonged PEI are evident in the fifth series, the first series after resumption of copulation. IF was significantly increased. While the decrease in MIH was not significant, the III₁ in the fifth series was significantly reduced.

EXPERIMENT 2

The significant decrease in EF in Experiment 1 was unexpected and is difficult to interpret. One possible

Table 1
Results of Experiment 1

Measure	Handled	60 Min.	t	p
EF	7.3	6.5	3.20	<.02
EL-Ser. 5	515.5	519.0	0.03	N.S.
IF-Ser. 5	8.3	11.0	2.38	<.05
MIH-Ser. 5	60.3	45.0	1.58	N.S.
III ₁ -Ser. 5	30.9	14.7	3.02	<.02

Table 2
Results of Experiment 2

Measure	Female	Handled	60 Min	F	p
EF	Same	7.6	7.1	< 1	N.S.
	Diff.	7.6	7.6		
EL-Ser. 5	Same	285.1	372.5	2.31	N.S.
	Diff.	886.2	204.2		
IF-Ser. 5	Same	6.7	10.6	19.0	< .01
	Diff.	7.9	7.9		
MIII-Ser. 5	Same	44.8	35.8	4.90	< .05
	Diff.	91.7	26.0		
III ₁ -Ser. 5	Same	32.8	14.4	24.0	< .01
	Diff.	48.1	9.4		

interpretation lies in the observation that the females generally appeared more resistant after the enforced PEI. Resistance on the part of the female might make copulation difficult and cause a premature termination of the session. Experiment 2 was conducted to test this possibility.

Subjects

The Ss were 16 male Rockland Long-Evans rats, approximately 170 days of age and with considerable copulatory experience at the beginning of testing. They were mated with 36 female Long-Evans rats 100 days of age at the start of testing.

Apparatus

The apparatus was the same as in Experiment 1.

Procedure

Each male received four tests spaced two weeks apart. As in Experiment 1, a 1 h PEI was enforced on half the tests and a control for handling run on the other half of the tests. On half the tests under each condition the original female was replaced with a different female that had been unmated in two weeks. A Latin-square was used to assign four rats to each of four running orders. Three rats were tested simultaneously. All other procedural details were identical to Experiment 1.

Results

The results of Experiment 2 were analyzed with 3-way analyses of variance with repeated measures (Winer, 1962) and are summarized in Table 2. In this experiment there was no significant effect of the enforced PEI upon EF. When comparisons are made on tests where the females were changed, the means are identical for the handled and 60 min tests. When the female is unchanged there is a reduction in mean EF in the same direction as in Experiment 1, but without statistical significance.

When data from the first series following the enforced PEI are examined, significant effects on IF, MIII, and III₁ are seen. Individual comparisons (Winer, 1962) revealed that when the female was unchanged, the results were identical to those of Experiment 1. IF was increased ($t = 5.06$, $p < .001$); MIII was not significantly altered ($t = 0.39$); and III₁ was decreased ($t = 2.80$, $p < .02$). When the female was changed, however, the only effects on Series 5 data were appreciable reduction in the IIIs with both MIII ($t = 2.83$, $p < .02$) and III₁ ($t = 5.90$, $p < .001$) significantly decreased.

DISCUSSION

The data from these two experiments reveal absolutely no tendency for 1 h enforced PEIs to increase the number of ejaculations attained before satiety is reached. When the female was unchanged, the effect of the enforced PEI was to

reduce EF in both experiments, although only the decrease in Experiment 1 was statistically significant. When the original female was replaced with a different one after the fourth series, there was no effect of enforced PEIs on EF. As the original females appeared more resistant to copulation after the 1 h interval as indicated by increased sparring, vocalization, etc., it is likely that the reduction in EF is a function of changes in the behavior of the female.

In addition to the studies reported above, pilot work in our laboratory has examined the effects of (a) enforcing periods of 30 min after each ejaculation, and (b) enforcing prolonged PEIs (11-20 min) that increased with each series as do ad lib PEIs after each series. In neither case was there any suggestion of an increase in EF.

These data cast some doubt on the proposal that sexual satiety is solely a function of non-sexual fatigue. If satiety is the product of fatigue, enforced PEIs must be viewed as rest periods during which fatigue dissipates. Dissipation of fatigue should prolong the copulation test. It may be the case that 1 h is not long enough for an appreciable amount of fatigue to dissipate. However, 1 h is a considerable rest period and it would seem that some suggestion of an effect, however small, should have been apparent. There was none. Thus it would seem that the fatigue hypothesis is weakened. Fatigue may play a part in sexual satiety, but it is unlikely that it is the sole factor. This conclusion fits well with the conclusion of McGill (1965) based on a different set of data.

The effects of enforcing a 1 h PEI after the fourth series in the present experiments were similar to those obtained with similar manipulations after the first series by Beach & Whalen (1959a) and Larsson (1961). Changing the female accentuated the effects of the enforced PEI on IIIs and eliminated the effect on IFs. We are presently examining the possibility of a similar effect of changing the female at the end of the first series.

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NOTES

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