

The Influence of Reproductive State On Infanticide by Wild Female House Mice (*Mus musculus*)¹

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Received 13 December 1984

McCARTHY, M. M. AND F. S. VOM SAAL. *The influence of reproductive state on infanticide by wild female house mice (Mus musculus)*. *PHYSIOL BEHAV* 35(6) 843-849, 1985.—The majority of female mice (*Mus musculus*) from laboratory stocks are spontaneously parental. In contrast, the majority of adult wild female house mice exhibit infanticide (the killing of preweanling young), but the frequency with which infanticide is observed varies as a function of age and reproductive state. Prepubertal females were less likely to exhibit infanticide (39%) than were adult virgin females (61%). The frequency of infanticide increased during pregnancy, with over 90% of females exhibiting infanticide just before parturition. But, after parturition, previously infanticidal females cared for their own litters. When lactating female mice were tested after two days of separation from their own nursing young for their behavior toward a novel newborn pup on either the tenth or twenty-fifth day after parturition, the proportion of the females that exhibited infanticide was not significantly different from that of adult virgin females (about 60%). After only two hours of separation from their own nursing young on the tenth day after parturition, however, all females continued to exhibit parental behavior toward a novel pup.

Infanticide Parental behavior Maternal behavior Pup killing Pregnancy Lactation Puberty

INFANTICIDE is defined here as the killing of conspecific preweanling young. Infanticide has been found to occur in male house mice, with the proportion of males exhibiting infanticide being dependent on the stock (cf. [31, 33, 56, 58, 59, 61]). It has generally been accepted that all but a few female mice are spontaneously parental, but in both inbred and outbred mice females can be induced to exhibit infanticide with exogenous testosterone treatment: the frequency of infanticide increases from around 10% in untreated females to 100% if testosterone levels are high enough [18], but the proportion of female mice that exhibit infanticide in response to testosterone treatment is dependent on the stock [30]. Infanticide in mice has thus been presumed to be a sexually-dimorphic trait that is characteristic of males and uncharacteristic of females.

We find that in both laboratory stocks and wild mice the complex of behaviors typically referred to as maternal behavior (e.g., nest building, retrieving, licking, and hovering over the pups) are also observed at specific times in males: between 12 and 50 days after mating virtually all male mice exhibit these behaviors [31, 59, 61]. We will therefore use the term "parental behavior" rather than the sex-linked term "maternal behavior" to refer to these behaviors. Thus, while

infanticide has been considered a sexually-dimorphic trait, parental behavior has recently been proposed to be a naturally-occurring behavior in both male and female mice [31, 59, 61].

The present study with wild female mice, as well as other studies with wild male and female mice [31, 32, 33], were undertaken due to our interest in the implications for population dynamics of female mice exhibiting infanticide at particular stages in their lives. Very few female mice from laboratory stocks exhibit infanticide, and the possibility that infanticide might be a naturally-occurring behavior in female mice had not been addressed until Jacobowski and Terkel [22] reported that the female offspring of mice wild-trapped in Israel all exhibited infanticide when tested in the laboratory. The present set of experiments was undertaken following our initial observation that most, but not all, wild female mice exhibited infanticide when exposed to a newborn mouse pup. Obviously, wild female mice could not exhibit infanticide at all times in their lives, since survival of young necessitates that at the time of parturition females exhibit parental behavior. The effect of reproductive state on the behavior of wild female mice toward young was thus examined.

¹This research was conducted in partial fulfillment of the degree of Master of Arts by MMM at the University of Missouri-Columbia and was supported by grants to FVS from NINCDS, NIH (NS 20075), NSF (BNS 8203714), and University of Missouri Biomedical Research Support Grant RR 07053 from NIH.

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GENERAL METHOD

Wild house mice (*Mus musculus*) were trapped using Sherman live traps in an abandoned building in a field on the Charles W. Green Experimental and Research Wildlife Management Area located in Boone County, MO. Approximately 100 mice were originally trapped (roughly 40 males and 60 females) and were then randomly bred in a closed colony. The animals were housed in rooms maintained at $23 \pm 1^\circ\text{C}$ on a 12:12 light:dark cycle with lights on at 0600 hr. All animals were housed in polypropylene cages ($18 \times 29 \times 13$ cm) with pine shavings. Purina breeder chow and water were available ad lib.

The animals utilized in the experiments were the F_1 - F_4 offspring of the mice wild-trapped in the field. These animals are referred to as wild-type mice since they do not represent a random sampling of wild mice (about 20% of the pairs of wild-trapped mice did not produce young when mated in the laboratory). Matings were obtained with one male and one female per cage. The litters were weaned at 25 days of age and then housed in same-sex groups. All animals to be tested were housed individually for 5 days prior to an infanticide test, and all animals were naive, meaning they had no previous experience with pups unless specifically stated. When an isolated female was tested, one 2-day-old pup was placed into the corner of the cage, and the animals were left undisturbed for 30 min. Wild mice are very sensitive to the presence of people, and it was deemed unwise to attempt to remain near the cage of a test animal to closely observe its behavior. If at the end of 30 min the test animal was found in the nest hovering over the pup, the behavior was recorded as "parental." If the pup was found dead, the behavior was recorded as "infanticidal," and if the pup was cold but unharmed, the behavior was recorded as "untouched." It was not possible to determine whether a pup had actually been left completely untouched by the test animal. But, when a pup was found unharmed and not in the nest, the behavior of the test animal was recorded as untouched even though there may have been contact with the pup.

With the exception of Experiment 1 in which adult females were tested with both wild-type and CF-1 albino mouse pups, 2-day-old mouse pups from the CF-1 albino laboratory stock were used as the stimulus animals to test for the behavior of female mice toward young. It has been observed that isolated male mice from laboratory stocks do not behave differently toward pups from the same or a different stock in terms of the likelihood of exhibiting infanticide [50]. Also, wild male and female mice do not behave differently toward laboratory stock or wild pups [22]. The sex of the young also does not influence the frequency of infanticide in laboratory male mice [59,61]. This does not mean that the test animals cannot discriminate between wild and albino mouse pups. In fact, laboratory female mice have been reported to be able to distinguish their own from unfamiliar young [7].

METHOD AND RESULTS

Experiment 1: Infanticide by Virgin Females

(A) The purpose of the first experiment was to examine the behavior of wild-type female house mice trapped in Missouri when they were exposed to either albino or wild-type 2-day-old mouse pups.

Isolated virgin wild-type females between 90 and 110 days of age, with no previous exposure to pups, were tested for infanticidal behavior by placing a 2-day-old CF-1 albino pup

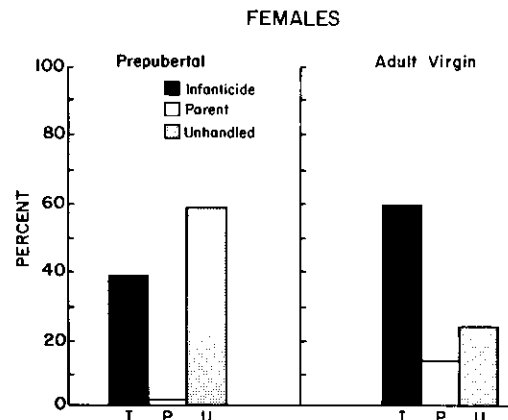


FIG. 1. Behavior of different groups of prepubertal ($n=31$) and adult ($N=83$), virgin wild-type female mice toward a single CF-1 mouse pup placed into each female's cage for 30 min.

into each female's cage. Of 83 adult virgins tested, 61% exhibited infanticide, 15% exhibited parental behavior, and 24% left the pup untouched (see Fig. 1). Some of these females were then retested for their behavior toward young at a later time. Other isolated virgin females were tested for their behavior toward a 2-day-old wild-type mouse pup. Of 20 females tested, 55% exhibited infanticide, 25% exhibited parental behavior, and 20% left the pup untouched, which is not statistically different from the frequencies observed when females were tested with CF-1 albino mouse pups. Nine isolated virgin females were also tested for their behavior toward a single 8-day-old wild-type mouse pup, and 45% exhibited infanticide, 33% exhibited parental behavior, and 22% left the pup untouched. These data are not statistically different from the results for females that were tested with 2-day-old pups. It appears, therefore, that wild-type virgin female mice do not differ in their tendency to exhibit infanticide or parental behavior based on whether they are tested with albino or wild-type mouse pups. In addition, the age of the pups (2-8 days old) does not influence the likelihood that wild-type female mice will exhibit infanticide, which is also true for male mice [59,61].

Adult virgin CF-1 female mice (derived from a stock originally purchased from Charles River Farms (MA) in 1979 and maintained as an outbred stock in a closed colony) were examined for their behavior toward a 2-day-old CF-1 mouse pup. Twenty CF-1 females were tested, and 25% exhibited infanticide, 60% behaved parentally, and 15% left the pup untouched. Although this frequency of infanticide for CF-1 females is somewhat higher than that reported for similarly-aged females from other laboratory stocks [30,52], it is nonetheless significantly different from that of similarly aged wild-type females tested with 2-day-old CF-1 mouse pups, $\chi^2(2)=18.4, p>0.001$.

(B) Mann *et al.* [30] have reported that female C57BL/6J mice are more likely to exhibit infanticide prior to puberty than in adulthood. This finding led to the hypothesis that ovarian hormones act to inhibit infanticide. We repeated the infanticide testing procedure used in the previous experiment (and also used by Mann) with prepubertal wild-type females that were between 35 and 40 days of age. The animals weighed under 15 grams, and vaginal opening had not yet occurred. Thirty-one prepubertal virgins were tested with CF-1 mouse pups: 39% exhibited infanticide, 3% exhib-

ited parental behavior, and 58% left the pup untouched. Pre-pubertal wild-type females are thus significantly less likely to exhibit infanticide than are adult virgin wild-type females, $\chi^2(2)=12.41$, $p<0.01$; see Fig. 1.

(C) There has been some concern among researchers who investigate infanticide that the testing of animals in their home cages with a single pup is less "natural" than a test in which an animal is allowed to come in contact with a lactating female and her newborn young. Virgin females were therefore tested by being placed into the home cage of a lactating wild-type female and her 2-day-old young, and the behavior of the virgin female was recorded as infanticidal or noninfanticidal depending on whether the pups were dead or alive 12 hours later. Again, the animals were not directly observed due to concerns that the continued presence of an observer would influence the behavior of the mice. We attempted to minimize the amount of disturbance to the lactating females by placing the virgin females into the cages without letting the lactating females escape, since handling of lactating females and short-term (2 hr) removal of the litter can induce infanticidal behavior in some females (see Experiment 3A). We have observed in our colony of wild mice that just handling the cage of a lactating female, without actually handling the lactating female and her litter, does not induce infanticidal behavior. Also, when a noninfanticidal mouse is placed into the cage of a lactating female, none of the pups are harmed [31].

Ten adult virgin females were placed into the cage of a lactating female (a relatively small sample was used to minimize the loss of life of pups), and in 50% of the cages the pups were killed, while in the remaining 50% of the cages the pups were alive (in all cases in which infanticide occurred, the entire litter was killed, and killing of the entire litter was considered as one infanticidal event). Given the assumption that where infanticide occurred, it was the virgin female that killed the pups, there is no significant difference in the behavior of virgin female mice toward young based on the two testing procedures that we utilized (placing a virgin female into the cage of a lactating female and placing a single pup into a virgin female's home cage).

Experiment 2: Infanticide by Pregnant Females

Because infanticide by laboratory stock females is uncommon, studies involving pregnant mice have concentrated on the onset of parental behavior [36, 41, 53] and the induction of postpartum aggression [45,51]. This study investigated the behavior of pregnant, wild-type house mice toward a single 2-day-old CF-1 pup that was placed into each female's home cage.

(A) Virgin females were paired with males. When females became visibly pregnant (about 14 days after mating), they were isolated, and testing began two to three days later (wild mice have an 18 day gestation period). Pregnant females were tested in the afternoon of each day until parturition occurred, so that all animals were tested on the day prior to delivering (no female was tested more than 3 times, and the behavior of the females on all of the test days was virtually always the same). The behavior of the pregnant females on the day before parturition was utilized in the statistical comparisons with other groups. Of the 20 pregnant females that were tested for infanticide on the last day of gestation, 90% killed the pup, 5% behaved parentally, and 5% left the pup untouched (see Fig. 3). All but one of these females subsequently cared for their own litters. Statistical analysis revealed that in relation to adult virgin wild-type females tested

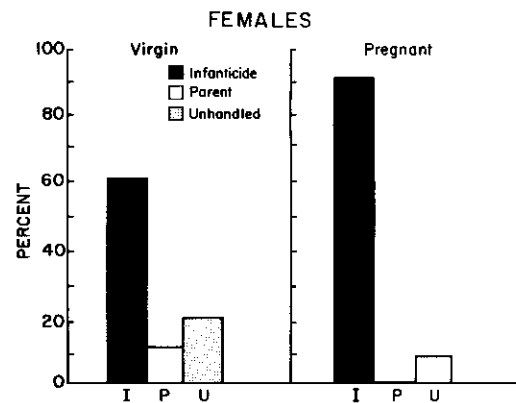


FIG. 2. Behavior of wild-type females (N=22) toward a single CF-1 mouse pup placed into each female's cage for 30 min. The females were tested for the first time while they were virgins and then again on the last day of pregnancy.

in a similar manner (61% exhibited infanticide), there was a significant increase in the frequency of infanticide one day prior to parturition, $\chi^2(2)=5.98$, $p<0.01$.

(B) In order to avoid the repeated testing of females during pregnancy that was required in the previous experiment (since the exact time of mating was unknown), another experiment was performed in which females were time-mated (paired with a male and checked daily for the presence of a vaginal plug) and then tested once on the last full day of pregnancy (Day 17) for their behavior toward a single 2-day-old CF-1 pup. Of the 22 females tested, 82% exhibited infanticide while 18% behaved parentally; none of these females left the pup untouched. When compared to virgin females, the response of time-mated, pregnant females toward young on the day prior to parturition was significantly different, $\chi^2(2)=5.71$, $p<0.05$.

Experiment 2A was conducted because we had initially hypothesized that the time-mating procedure might inadvertently select for a subgroup of females. When females are time-mated they must be examined daily for a vaginal plug. This procedure is obviously stressful to wild mice as demonstrated by the fact that in this study (as well as other experiments that we have conducted) only about 60% of the animals originally time-mated are found to have plugs, and only half of these females will complete the pregnancy to term (about 30% of the original group that was mated). This wastage is most likely due to interference with the capacity for female mice to maintain pregnancy when stressed prior to implantation, since pregnancy is blocked in wild mice by changing the cage of recently inseminated females [8]. In contrast, 80% of time-mated CF-1 females produce young. We find that approximately 95% of wild-type females that are mated in the lab by being left undisturbed in a cage with a male for at least two weeks will successfully wean a litter (this is somewhat higher than the proportion of wild-trapped male and female pairs that produced young). We therefore conducted the prior experiment due to the concern that the time-mating procedure might select for females that were more resistant to the stressful effects of handling, which in turn could be correlated with infanticidal tendencies (cf. [56]). However, the frequency of infanticide by pregnant, time-mated females was not significantly different than that observed in females from the previous experiment that were not disturbed after being paired with a male.

(C) A randomly-selected group of 22 females that had been tested for infanticide as virgins (see Experiment 1A) were retested at the end of pregnancy using the procedure described in Experiment 2A. The purpose of this experiment was to examine whether individual females would change in their behavior toward young after becoming pregnant. Sixty-three percent of these females exhibited infanticide as virgins, 14% exhibited parental behavior, and 23% left the pup untouched. One day before parturition 91% of these females exhibited infanticide, while the remaining 9% left the pup untouched (see Fig. 2). Chi-Square analysis could not be performed on these data since the same animals were tested twice, but the McNemar's test for the significance of changes revealed that there was a significant increase in the proportion of females exhibiting infanticide on the day prior to parturition relative to when the females were virgins, $\chi(1)=4.2, p<0.05$.

Experiment 3: Infanticide by Lactating Females

A link has been established between suckling stimulation and postpartum aggression in female house mice [46]. It has been demonstrated that removal of pups from a lactating female mouse for 5 hr (but not one hour), will result in a reduction in postpartum aggression [45]. The purpose of the current study was to examine whether there is a link between events associated with the presence of young and the inhibition of infanticide in lactating wild-type female house mice.

(A) A screening procedure was established to eliminate nursing females that exhibited infanticide after a 2-hr separation from their young. Isolated females were allowed to deliver their litters in their home cages. On the second day postpartum the pups were removed. The females were also handled, since when the pups were removed from the nest, the females always jumped out of their cages into a holding tank. After an interval of 2 hr, one 2-day-old wild-type pup (not one of the female's own pups) was returned to each female with a minimum of disturbance (the females did not escape from their cages), and the behavior of each female toward the pup was recorded after 30 min. Females that behaved parentally were given back three more pups in order to equalize litter size as well as the degree of suckling stimulation each female received. Fifty females were screened for infanticidal behavior on the second day postpartum, and 26% exhibited infanticide (the remaining females exhibited parental behavior). Only females that behaved parentally during the screening test were utilized in the next test.

(B) On the eighth day postpartum, the litters of 37 previously screened females were removed for a period of either 2 (N=12) or 48 (N=15) hr, after which one 2-day-old wild-type pup was placed into each female's cage for 30 min. An additional 10 females had their litters removed for 2 hr on Day 10 postpartum to control for the possibility of a change in behavior between Days 8 and 10 of lactation. None of the females that had their litters removed for 2 hr on Day 8 or Day 10 postpartum killed the pup during the test. Of the 15 females that had their litters removed for 48 hr, 47% exhibited infanticide, while the remaining 53% exhibited parental behavior toward the test pup. Females deprived of their litters for 2 days were thus significantly more likely to exhibit infanticide than were females deprived of their litters for only 2 hr (Fisher Exact Probability Test; $p=0.0133$). In addition, the behavior toward a test pup of females deprived of their litters for 2 days was not significantly different from the behavior of virgin females.

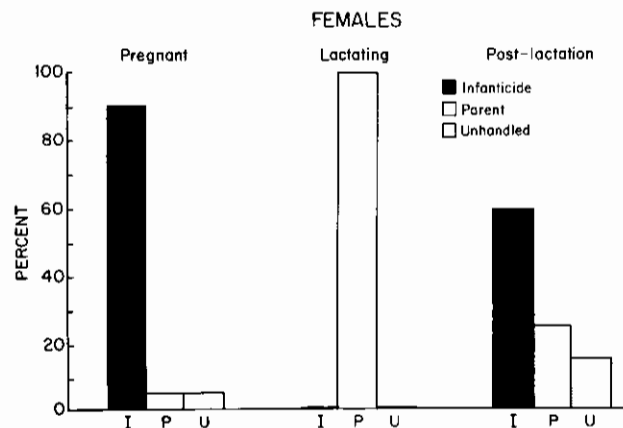


FIG. 3. Behavior of different groups of wild-type female mice toward a CF-1 mouse pup placed into each female's cage for 30 min. The behavior of pregnant females (N=20) that were not time-mated was recorded for the last full day of pregnancy. The lactating females (N=12) had their litters removed 2 hr before the test on Day 8 following parturition. The post-lactation females (N=15) had weaned their litters when the young were 23 days old, 2 days prior to the test.

(C) Females that had successfully reared and weaned litters were tested for infanticidal behavior 2 days after removal of the weanlings (at 25 days postpartum). None of the females were pregnant at the time of testing, and they will be referred to as "post-lactation females" (see Fig. 3). Of the 15 females that were tested, 60% exhibited infanticide, 26% behaved parentally, and 14% left the pup untouched. This frequency of infanticide is virtually identical to that of virgin females (61%).

GENERAL DISCUSSION

Infanticide in house mice has traditionally been considered an androgen-dependent behavior [56], with only males regularly killing young. The frequency of infanticide by both outbred and inbred female mice averages around 10%. Specifically, less than 13% of DBA/2J and C57BL/6J adult virgin females spontaneously exhibit infanticide [52] and about 8% of Rockland-Swiss females are infanticidal [10]. In the current study 25% of adult virgin CF-1 females were infanticidal. Examination of wild house mouse females has revealed, however, that they are more likely to exhibit infanticidal behavior than their laboratory stock counterparts. Jakubowski and Terkel [22] reported that 90–100% of virgin female wild house mice in Israel spontaneously killed neonates. The current results indicate that 50–60% of naive, virgin female wild-type house mice from Missouri kill neonates (see Fig. 1). The fact that wild female mice from Missouri are less likely to exhibit infanticide than those from Israel may be the result of either inherent differences between two geographically separated subspecies or some aspect of the testing procedure, which was different in these two studies. In summary, Jakubowski and Terkel did not observe a sex difference in the proportion of sexually-naive wild mice that exhibited infanticide (virtually all males and all females exhibited infanticide) while we did observe a sex difference (virtually all males exhibited infanticide while about 60% of females exhibited infanticide; [31,33]). Thus, in contrast to the conclusion drawn from studies with laboratory stocks of mice, both

our findings and those of Jakubowski and Terkel reveal that it is inappropriate to consider infanticide to be a behavior normally exhibited by male mice but not by female mice. But, why some wild-type females exhibit infanticide while others are spontaneously parental toward young remains to be elucidated.

Examination of wild-type mice has also led to different conclusions about the ontogeny of infanticidal behavior from those arrived at in studies utilizing laboratory stock mice. Infanticidal behavior has been reported to peak in 32 day old Rockland-Swiss females and decline thereafter [16]. Further studies revealed that 30–40% of prepubertal females from an androgen-deficient strain of mice (C57BL/6J) were spontaneously infanticidal, compared to virtually none for the DBA strain [30]. The difference between strains was eliminated when the animals reached early adulthood (older than 45 days), leading the authors to speculate that the onset of ovarian hormone secretions may have suppressed infanticide in C57 mice. In contrast, juvenile female Mongolian gerbils are less likely to kill neonates than are adult females [15]. Naive, prepubertal, wild-type female house mice are also less likely to exhibit infanticide than are adult wild-type females (see Fig. 1), suggesting that the finding that the frequency of infanticide decreases after puberty in laboratory stocks of female mice is a consequence of domestication.

The above findings suggested that in wild house mice, the onset of secretion of gonadal hormones at puberty might act to induce infanticide. We recently examined this possibility and found that the change in the proportion of wild-type female mice that exhibit infanticide between the juvenile period and adulthood was independent of the presence of the gonads and adrenals: neither ovariectomy and/or adrenalectomy performed prior to puberty or in adulthood influenced the behavior of wild-type female mice toward young [32].

There also appears to be an induction of infanticidal behavior during pregnancy in wild house mice. When tested on the last day of pregnancy, 90% of pregnant females exhibited infanticide, and only one out of 42 females that were tested exhibited parental behavior (see Figs. 2 and 3). Importantly, virtually all females that killed a neonate one day prior to parturition proceeded to care for their own litters, suggesting that some factor(s) associated with pregnancy induces infanticidal behavior while some factor(s) associated with parturition may act to suppress infanticide and initiate parental behavior. There is evidence that events associated with parturition might play a role in inducing parental behavior in some species. Hysterectomy rapidly induces parental behavior if performed after the 10th day of pregnancy in rats [40], and parental behavior in sheep is induced following stimulation of the vagina at birth [23].

Infanticidal behavior by pregnant females has been examined in other rodent species. An infanticidal female Mongolian gerbil is less likely to kill neonates as pregnancy progresses [15], and pregnant female hamsters that were infanticidal as virgins were found to kill and consume the first or second pup offered but to "intensively mother" subsequent pups [39]. It is interesting that successive presentations of pups to infanticidal male and female laboratory mice has been found to induce parental behavior in some previous killers [36]. The same mechanism has been reported to induce parental behavior in wild male mice trapped in Israel, but not in wild females [22]. Many of the female mice in Experiment 2A were given test pups on two or three consecutive days before parturition with no decrease in the tendency to exhibit infanticide.

Studies on parental behavior in laboratory stocks of mice have focused on nest-building, pup retrieval, etc., and incidents of infanticide (which are rare) have only been reported secondarily. The induction of infanticidal behavior in wild-type female mice during pregnancy is thus in marked contrast to findings from studies utilizing laboratory stock female mice in which a correlation between the onset of parental behavior and advancing pregnancy has been reported [3,37]. Applying the results of studies with laboratory stocks of animals to models of the behavior of animals in natural habitats is thus risky without first examining wild animals.

The inhibition of infanticide established around birth in wild-type female house mice appears to be maintained by continuous contact with young. A 2-hr period without exposure to nursing young was found to be without effect on infanticidal behavior, and all females continued to exhibit parental behavior. However, after a 2-day period without exposure to suckling young, there was a significant increase in the frequency of infanticidal behavior. Furthermore, post-lactation females that had weaned a litter were as likely to exhibit infanticide as were virgin females.

A link has already been established between suckling stimulation and postpartum aggression in laboratory stocks of house mice [46]. It appears that hormones secreted during pregnancy promote nipple growth, thereby allowing a female to receive suckling stimulation from her young immediately following parturition. Once postpartum aggression is established, however, it can be maintained by exteroceptive stimuli from the young [47]. Lactogenesis itself is also not essential for postpartum aggression, since a thelectomized female (nipples removed) in the presence of young will exhibit aggression equal to that of a lactating female [45]. Whether the regulation of the inhibition of infanticide and facilitation of parental behavior after parturition will be found to be similar to the regulation of postpartum aggression remains to be examined.

Hrdy [19] has proposed three circumstances in which infanticide could be adaptive for females. The first circumstance involves cannibalization of the killed infant, thereby exploiting it as a food source. For instance, female Syrian hamsters [20] and Mongolian gerbils [14] usually consume their victim after killing it; neither wild-type nor CF-1 mice that exhibit infanticide typically cannibalize the infant after it is killed. A second circumstance in which infanticide is hypothesized to be adaptive relates to resource competition. This occurs when the killing of infants results in more resources being available for those animals remaining alive. The resources being competed for may be food, nesting sites or territories. Infanticidal female Belding's ground squirrels are believed to kill the litters of other females in order to gain access to highly valuable and limited burrows [42]. A pregnant female that can prevent other females from successfully nursing young would be assuring available resources for her own offspring as well as reducing competition in the next generation. The infanticidal female may also be gaining a nutrient-rich meal if the victims are eaten. The importance of female infanticide in population regulation has only recently been considered. What were once unexplained instances of infant mortality in many species have now been proposed to be due to infanticidal females [5, 55, 57].

The third circumstance in which infanticide could be an adaptive behavior involves parental manipulation and refers exclusively to the killing of one's own young, which then increases the probability of survival of either the mother of

the victims or the remaining offspring. This category of infanticide includes the destruction of imperfect or debilitated young and may occur in response to environmental pressures as well as the threat of predation; this is believed to be an integral part of the reproductive strategy of female hamsters, which invariably cull their litters to an optimal size [11]. Similar findings have been reported in mice [17]. Another example of this category of infanticide is the selective killing of only male young by nutritionally-stressed lactating woodrats [34]. Food deprivation has also been shown to induce infanticide in house mice [48], and it has also been observed that lactating wild-type female house mice that are

food-stressed will selectively cull their litters by exhibiting infanticide in order to successfully wean one or two offspring (Glen Perrigo and F. H. Bronson, personal communication). Thus, the infanticidal classes defined by Hrdy [19] of resource competition, exploitation and parental-manipulation all may contribute to a high frequency of infanticide by female house mice in the wild. In conclusion, the current results suggest that we should re-evaluate our concepts concerning infanticide in female house mice and the role that this behavior may play in individual reproductive success, social structure and population regulation in house mice.

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