Automated Video Registration in Home Cage for Measuring Maternal Behavior of Wild, Aggressive and Tame Rats

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ABSTRACT

This work is aimed to study the maternal behavior using visual observation and automated video registration system in tame, aggressive and wild gray rats. It is shown that the frequencies of "outside the nest" and mother licking/grooming do not depend on the used methods in tame dams. The presence of observer is accompanied by decreasing of the frequency of these parameters in aggressive dams. It is supposed that this effect is associated with increased emotionality and stress responsiveness in aggressive females as compared with the tame females. The frequency of maternal arched-back nursing is decreased under visual observation compared with automated video registration in females of both lines. Maternal aggression of both selected lines and wild population is recorded using the same registration system. It is shown that maternal aggression towards unknown male conspecific is lower in wild rats, than in tame and aggressive ones.

Author Keywords

Tame and aggressive rats, maternal aggression, maternal behavior, visual observation, video registration.

INTRODUCTION

Maternal behavior in rodents is associated with long-term programming of individual coping capacities in the offspring. Gray rats selected for elimination and enhancement of aggressiveness towards human differs in emotionality, anxiety and stress response [5, 8]. Cross-fostering showed that postnatal maternal environment doesn't affect behavior in tame and aggressive rats but can influence corticosteroid stress response of tame rats [9]. It is still unknown whether there are differences in maternal behavior between tame, aggressive and wild rats. There are a lot of factors that should be considered when evaluating parental behaviors in rodents. The different methods of data collection can provide very different results and may influence on their interpretation [3]. Thus, it is interesting to study the maternal behavior in different rat lines and to compare methods of visual observation and automated video registration.

MATERIALS AND METHODS

Maternal Behavior

The study of maternal behavior was conducted on tame and aggressive female rats. At the age of 4 month each female was placed in cage with male. On the 20th day we put males away. One part of dams was left in their cages for subsequent visual observations. Visual observation of maternal behavior was carried out from 2 to 12 postnatal days. Different behavioral parameters were measured in 5 minutes during one hour twice a day according to standard protocol [4]. Total number of observations for one female was 20 in day. For this experiment 15 tame and 15 aggressive females were used. Another group of pregnant females (8 tame and 8 aggressive females) were placed in special home cages with front wall made of clear plastic for automated video registration. In front of each home cage there was a highly sensitive black-and-white video camera 1/3" CCD with automated diaphragm tuning. Our observation system allows sequentially record image data

from different cameras. Switchboard Kramer V016 was used to switch from one camera to another. We supplied each home cage with infrared source for video registration in dark phase of the day. Automated video registration was carried out from 2 to 12 postnatal days during one hour 5 times a day (09.00, 14.00, 18.00, 22.00 and 06.00). Total number of observations for one female was 100 in day. After video recording trained observer watched the video and assessed behavioral parameters. Following parameters of maternal behavior were estimated: mother is in nest, mother licking and grooming pup, and mother nursing pups [4]. Nursing posture was rated as either an arched-back posture when the mother was arched over pups with legs extended, a "blanket" posture in which the mother lays over the pups with no leg extension, or a passive posture in which the mother is lying on her back or side while the pups nurse. Percentage of each behavior from total number of observations was assessed. The percentage of licking and grooming of pups was estimated from number of observations during which the female was inside the nest.

Maternal Aggression Test

Automated video registration system, developed in our laboratory, allows not only prolonged repeated registration during selected time intervals, but also single video registration from selected camera. This is very useful for many behavioral tests that are conducted in home cages. One of such test is maternal aggression test. The study of maternal aggression was made using 10 tame, 10 aggressive rats and 5 rats from unselected wild population. During this test unfamiliar male Wistar rat was placed in home cage of female with pups. The test was held on 6 postnatal days during 5 minutes. The behavior of lactated rats was videotaped, and following behavioral elements [7] were scored using special computer program: aggressive behavior (attack, chasing, kicking, offensive upright, keep down, lateral threat), social explore (moving toward, nosing, anogenital sniffing), nonsocial behavior (locomotion, rearing, self-grooming, sitting, lying). The computer program made in our laboratory allows assessing the latency, time and number of each behavioral pattern. The time of all behavioral elements, the number of aggressive behaviors and the latency of the first attack were measured. The time of maternal care was calculated as total time witch rat spent inside of the nest or carrying pups. The parameters of maternal behavior were analyzed using ANOVA and Kruskal-Wallis ANOVA analysis, a p value of <0.05 was accepted as significant.

RESULTS

Maternal Behavior

Analysis of the results showed that tame females spent less time in nest than aggressive ones. There was no difference in this parameter in tame rats while using automated registration and visual observations. Aggressive females spent less time in their nests in the presence of observer. The same differences were shown for frequency of nursing. It is important that some estimations of maternal care were significantly lower in dark phase of the day than in light phase. Arched-back nursing posture was the main for both tame and aggressive rats. Tame mothers nurse less frequently in arched-back and more frequently in passive posture, than aggressive. Females of both lines had lower frequency of arched-back posture in the presence of human than under automated video registration. These animals demonstrated an increasing of "blanket" posture. The frequency of licking-grooming was lowest in aggressive mothers under visual observations.

Maternal Aggression

Using Kruskal-Wallis ANOVA analysis it was shown that wild females attacked intruders later than tame and aggressive ones. Number of attacks and total time of aggression were significantly lower in wild than in tame and aggressive mothers. The numbers of upright postures, kicking, chasing, pinning and lateral threats were lower in wild rats than in tame. Also the number of upright postures and kicking was higher in aggressive animals than in wild ones. There were no significant differences in behavior of tame and aggressive lactated rats except the number of pinning. Social non-aggressive behavior of wild, tame and aggressive rats didn't differ. The time of "individual behavior" was significantly lower in tame than in wild mothers. Total time of maternal care was higher in wild than in tame and aggressive rats.

DISCUSSION

Our results show that the presence of observer influences the behavior of aggressive females stronger than the behavior of tame ones. Earlier it was shown that aggressive rats are more anxious than tame [8, 9]. Probably, high anxiety of aggressive females can be a reason why they spent more time with pups in the presence of human. The type of nursing and licking-grooming frequency are important factors of maternal care [1, 2]. There are three main nursing postures but the most effective for nutrition of pups is an arched-back posture. Dams of both lines showed increased "blanket" posture during visual observations. Probably, the presence of human could increase the defensive behavior of animals and we suppose that the "blanket" posture was its part. Licking-grooming frequency was lower in the aggressive mothers under visual observations than in other groups. Our results show that the presence of the human affects frequency of licking-grooming in the aggressive mothers and doesn't influence this parameter in the tame ones. Thus, the presence of observer attenuates maternal care in aggressive rats. It is shown that maternal aggression towards unknown male conspecific is lower in wild rats than in tame and aggressive ones. Low anxiety of tame rats and high aggressiveness of aggressive ones could result in their high maternal aggression. Earlier it was shown that some strains of laboratory rats are characterized by high maternal aggression [6]. It should be mentioned that wild rats demonstrate defensive postures in the presence of human so

automated video registration is necessary for objective study of behavior.

Thus, our results show that genotype-dependent behavioral features of rats can affect manifestations of maternal behavior while using visual observation method. The behavioral patterns of maternal care and maternal aggression are very complicated for automatic identification. Therefore, we used automated video registration of behavior according the table and then analyzed patterns using standard program. But now we are developing special system of automatic monitoring of rat diurnal activity. The method of image analysis is the basis of new approach to this task solution.

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