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Original investigation

Intra-family aggression and offspring expulsion in Mongolian gerbils (*Meriones unguiculatus*) under restricted environments

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Abstract

Mongolian gerbils live in families consisting of a founder pair, to which reproduction is mainly restricted, and the offspring. They are described as cooperative breeder in which males and offspring act as helpers. Family dynamics have not been systematically investigated, particularly concerning the long-term consequences of periods of aggression. In a conceptual framework, promoting factors were investigated for the outbreak of aggression and its consequences on the families and on the individual level. Moreover, previously defined and described integrated (IFMs) and expelled family members (EFMs) were further characterized by frequent measurements of body mass and body composition. Six families were monitored for at least 1.5 years under controlled laboratory conditions. Regularly, the family composition and the individual state of each family member were inspected. In case of agonistic interactions, aggression periods were characterized by onset, number, duration, number of expelled animals and family size. First aggression period has been occurred 247.8 ± 37.7 days post-founding. As a consequence, family size was reduced significantly from 18.7 ± 1.8 to 17.5 ± 1.8 animals; the number of females decreased too from 10.6 ± 1.8 to 9.7 ± 1.8 females per family. All Mongolian gerbils experienced 2.4 ± 0.2 aggression periods per life. All EFMs had a reduced body mass increase during aggression periods compared with integrated ones. Expelled males had a lower body mass than their integrated siblings; there was no such difference in females. In each aggression period, 2.6 ± 0.2 adult animals per family were expelled. There was no sex-specific expulsion rate. Mainly founder females acted as aggressors (in 60% of all aggression periods). Up to three animals operated together aggressively, but mainly only one animal attacked the other family members (in 78% of all aggression periods).
To conclude, animals of both sexes were excluded due to changes in family structure and an increased family size. Furthermore, females were expelled due to competition for exclusive reproduction. Males with lower body mass were more prone to be expelled, whereas in females no morphometrical characteristics favour the expulsion.

Key words: *Meriones unguiculatus*, expulsion, body composition

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Introduction

Mongolian gerbils are socially living rodents found in the semi-deserts and steppes in Mongolia and Manchuria. Families are based on a founder pair, to which reproduction is exclusively restricted. Sexual maturation of daughters is suppressed (Marston and Chang 1965; Adams and Norris 1973; Payman and Swanson 1980; Clark and Galef 2001). The founder male does not have exclusive access to the breeding female; even sons and males from adjacent families copulate with the founder female (Roper and Polioudakis 1976; Swanson and Lockley 1978; Ågren 1981, 1984). The Mongolian gerbil is known for intensive pro-social behaviour such as communal foraging, grooming, defence of the family territory and cooperative breeding (Thiessen et al. 1977; Gromov 1981, 1990; Ostermeyer and Elwood 1984; Salo and French 1989; Weinandy and Gattermann 1999). Family members are identified by a family odour, which is mainly produced by the ventral gland of high-ranking family members such as founders (Thiessen et al. 1971). Aggression against non-family members is well known and interpreted as defence of the family territory (Ginsburg and Braud 1971; Reynierse 1971; Thiessen and Yahr 1977; Le Guelte et al. 1987; Gromov 1990). Moreover, intra-family aggressive behaviour has also been observed in the Mongolian gerbil. Although a sophisticated analysis is still lacking, the competition for reproductive access has been found as a major trigger (Roper and Polioudakis 1976; Swanson and Lockley 1978; Clark and Galef 2001).

In order to further elucidate family dynamics, we previously suggested that there are three social categories in family groups based on aggressive interactions and parameters indicating stress: (1) founder pairs remained in their family and reproduced; (2) integrated family members (IFMs) remained in their natal family but did not reproduce; (3) expelled family members (EFMs) were attacked (Scheibler et al. 2004). Animals in these categories were further characterized by their body mass and body composition, because the parameters were developed to illustrate the status of an animal, its resources and level of stress-implications (ground squirrels: Nunes et al. 1996, rats: Harris et al. 1998, murines: Breed and Taylor 2000). Changes in body composition may reflect the state of metabolic stress (rats: Zhou et al. 1999; golden hamsters: Wade et al. 1986; Meisel et al. 1990; mice: Laugero and Moberg 2000). The rapid, safe, in vivo technique of recording total body electrical conductivity (TOBEC) allows repeated determination of body composition and has been successfully applied to the Mongolian gerbil (Weinandy and Gattermann 2001).

The following issues were addressed in the present investigation: (1) What are the causes for the outbreak of agonistic behaviour? (2) How can these periods of aggression be characterized? (3) What are the consequences for the families? Are there differences between the members of the social categories that explain the expulsion of some individuals but the retention of others in the family unit?

Material and methods

Animals and housing conditions

Six families of *Meriones unguiculatus* were each based on one founder pair. Females were from our laboratory breeding stock (Zoh: CRW) going back to three breeding pairs obtained from Charles River Wiga (Sulzfeld, Deutschland) in 1992. The founder males were descended from wild animals caught in 1995. Each founder pair was housed in an enclosure enriched with a sand bath as well as tree roots and limbs. Three enclosure sizes were used to produce different family densities. Two families were kept in an area of 1.5 m^2, two on an area of 2.6 m^2 and the remaining two on 4.3 m^2. The floor of all enclosures was covered with wood shavings (Allspan Animal bedding, The Netherlands). Tap water and food pellets (Altromin GmbH Lage) were available ad libitum. Chow was supplemented with sunflower seeds, walnuts, fruits and hay. The temperature was 25 ± 3 °C and the light/dark conditions were 14:10 h (lights-on at 5 h am), the light intensity varied from 100–300 lx (light period) to 5 lx (dark period). All individuals (> 50 g body mass) were tagged by passive subcutaneous transponders (Trovan Ltd., UK).

If there was a loss of all reproductive females, observation was broken up. Such a family group,