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Guinea Pig Pups do Recognize Their Mother

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In order to demonstrate mother recognition by guinea pig pups (*Cavia porcellus*), pups 7 to 14 days of age were tested in a two-choice apparatus with two wire-mesh delimited compartments where their mother and an unfamiliar lactating female were placed. Pups spent about the same amount of time, at farthest parts of the apparatus, in the mother's as in the unfamiliar female's side, but remained significantly longer near their mother at short distances. The pups' distress whistles decreased and non-aggressive, social chuts increased the nearer the pups got to the females. Vocalizations nevertheless did not differ according to side of the apparatus. Results show that domestic guinea pig pups do recognize their mothers, even if not allowed to get into close contact and to interact with them.

Index terms: Mother recognition. Animal vocalizations. Guinea pigs. Cavia porcellus.

Filhotes de cobaia reconhecem sua mãe. Para verificar se existe reconhecimento da mãe por parte do filhote da cobaia doméstica *Cavia porcellus*, filhotes de 7 a 14 dias foram testados num dispositivo no qual estavam, presas em compartimentos de contenção delimitados por uma tela de arame, a mãe e uma fêmea lactante desconhecida. Embora, na parte mais distante do dispositivo, os filhotes não demonstrassem preferência pelo lado da mãe, eles permaneciam significativamente mais tempo do lado desta na parte do dispositivo mais próxima aos compartimentos de contenção. Os assobios do filhote, indicativos de aflição, diminuiam e a vocalização *chut*, indicativa de contato social não-agressivo, aumentava com a proximidade às fêmeas. Não houve diferença significativa entre as vocalizações emitidas do lado da mãe e as emitidas no lado da outra fêmea. Os resultados indicam que há, na cobaia doméstica, reconhecimento da mãe mesmo que não sejam permitidos contato direto e interação.

Descritores: Reconhecimento da mãe. Vocalizações animais. Cobaias. Cavia porcellus.

Parent-offspring recognition is an adaptive feature of behavior which has presumably evolved in accordance with social-ecological pressure. Parents ought to learn to recognize their offsprings whenever there is a possibility that they might misdirect parental care to strangers. Under such conditions, discrimination of own infants can clearly play a role in increasing fitness returns of parental efforts. The infant's benefits of recognizing the mother or parents or relatives can also be relevant from a functional point of view. Recognition of parents should be expected to occur when infants fail to obtain prompt care or protection or might even suffer aggressive attacks from other adult conspecifics, from the same or different neighbour groups. Recognition frequently works in both ways – infants and parents recognizing each other – but this is not always true (Beecher, 1991).

Domestic guinea pigs, *Cavia porcellus*, are a very social species. They explore and forage and stay most of the time in close proximity to each other. Social organization is marked, whether at low or high population levels, by male dominance hierarchies: highest ranking males have a privileged access to the several females of their group or subunit and sire most of the offsprings (Sachser, 1998). In a guinea pig group, the simultaneous presence of young

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in suckling age from different females makes "errors" of social orientation (an infant attempting to suckle from a non-related lactating female) probable and one would expect a certain degree of offspring recognition and selectivity in mothers' behavior. Mother recognition by pups, on the other hand, is not so clearly predictable as we do not know to what extent pups are rejected or attacked by non related lactating females.

In *Cavia porcellus*, the recognition of pups by mothers have indeed been demonstrated. In a study by Porter, Fullerton, and Berryman (1973), 12 mothers of recently-born litters were tested in a two choice apparatus, with their own pups in one of the compartments and unfamiliar pups in the other one. Compartments were situated at the end points of an alley. All females but one spent more time near their own litter than near the other one. Females also spent significantly more time near a compartment scented with an odour previously applied to their offsprings than near a compartment with a novel odour, a result which indicates that olfactory cues may play a role in the discrimination of pups. Recent research in our lab, done with a differently structured apparatus, have confirmed the conclusions of Porter et al. (1973).

Results about the recognition of the mother by pups have not been consistently positive or conclusive. Porter et al. (1973) reported an experiment with pups, one to 23 days of age, also tested in a two-choice alley. The results revealed no significant difference in time spent near the pups' mother or near another lactating female and led authors to conclude that "early maternal-young interactions of guinea pigs are enforced primarily by the mother" (p. 494).

In Pettijohn's experiment (1979b), pups 2, 4, 6 and 8 weeks old were put in a box where, in separate compartments closed by wire mesh, were their mother and father. Younger infants (2 and 4 weeks old) spent significantly more time, during five-minute sessions, near the mother's compartment than near the father's. Although such results reinforce the idea that juveniles are more attached to their mothers than to their fathers, as was inferred by Pettijohn, they do not allow one to conclude that they discriminate their mother as an individual (theirs could simply be a preference to stay near a lactating female).

Fullerton, Berryman, and Porter (1974) observed the behavior of pairs of guinea pig females and their respective litters kept in the same cage. They observed that pups suckled more from their mother than from the other lactating female – a hardly suprising result - and that they stayed more in contact with her than with the other female. Pups that were temporarily taken out of the cage and then reintroduced terminated significantly more initial approaches to mother with suckling than initial approaches to the other female. The authors' conclusion was that while pups did not differentiate mother from non-mother at a distance, they could recognize the mother after contact was made, probably through olfactory cues. A further study in which it was shown that infant guinea pigs preferred to interact with their own mother than with a virgin female or an adult male was interpreted as bringing more evidence about a proximate cue explanation of mother recognition (Berryman & Fullerton, 1974).

Other indications of mother recognition were all obtained in a contact (or lack of contact) situation. Infant guinea pigs emit a higher rate of distress whistles when alone than when accompanied by their mother (Pettijohn, 1979a); infant and juvenile guinea pigs show elevated cortisol and distress vocalizations when tested apart from the mother than when in her presence (Henessy, Mazzei, & McInturf, 1996; Ritchey & Hennessy, 1987). Other adult conspecifics may also cause a decrease in whistle rate, sometimes as marked as the one induced by the presence of the mother (Tokumaru, 1995).

The time spent by a pup in contact with mother or with other adult animals is not however a full proof criterium of recognition:

this time may depend on the adults' reaction to pup approximation. A benevolent adult may make contact last longer than a hostile one; the pup's mother may behave differentially according to whether she recognizes her offspring or not. So, although suggestive, the available information about mother recognition in guinea pigs is not completely satisfactory. What seems to be needed is a preference test in which the adults' reaction to pups might be suppressed or controlled.

The present research is an attempt to provide such a non-interactive test of mother recognition by infant guinea pigs. As Porter et al. (1973), we used a two-choice apparatus, but we put the social stimuli (the pup's mother and a lactating female) in adjacent compartments separated from the rest of the apparatus by a wire mesh screen. Besides recording the spatial position of the pups, we recorded their "chut" and "whistle" vocalizations (Berryman, 1976). Whistles, as already mentioned, are usually produced by isolated infants and serve as a measure of degree of distress; chuts occur mostly in non-aggressive social context or during environmental exploration. We thought that such vocalizations, if emitted differentially on the mother's and on the strange female side, would provide one more clue to the nature of the recognition process eventually involved in the testing context.

Method

Subjects

Eight female guinea pig (*Cavia porcellus*) – 6 obtained from the São Paulo Zoological Foundation and 2 from our own colony, at the Department of Experimental Psychology, University of São Paulo – and their litters were used. Total number of pups was 22 (10 male and 12 female). Each mother and her litter were housed in a white plastic cage (65 x 32,5 x 34 cm) with hard wood chip bedding. Guinea pig chow and fresh vegetables (carrots and lettuce) were given once a day. Water was freely available, but was changed every day. The colony room was maintained at 22^0C on a 12:12 hr light/dark cycle (lights on at 0700h).

Procedure

Testing was performed in a white, uncovered plastic box (92 x 55 x 57 cm), the floor of which was marked off into areas by tape strips and covered with wood chips taken from the cage of the pup to be tested (Figure 1). Two adjacent cages (25 x 15 x 15 cm), with a front part made of wire mesh, were positioned at one of the ends of the test box, to be used as confinement cages for mother and unfamiliar female. Females were chosen so as having parturitions close in time (from 1 to 7 days interval).

Pups 7 to 14 days old were submitted to 3 trials, on consecutive or alternate days, depending on litter number. Trials were scheduled to occur between 10:00 and 12:00. On each trial, two families were transported from the colony to a room in the laboratory and left there, undisturbed, in their home cages, for at least one hour. The mother and the unfamiliar lactating female were then taken to an adjacent room – where testing was to be performed – and placed into the confinement cages, the position (right/left) of each one being randomly determined. five minutes later, the pup was carried and put into a little wire-mesh cage at the opposite end of the apparatus and was released, after a one-minute interval, by the raising of this cage through ropes manipulated by the experimenter from another room, being allowed to explore for 15 minutes.

Trials, performed without the presence of experimenters in the room, were videorecorded for subsequent analysis. Dependent variables were: (1) time spent by the pup in each one of 7 areas of the apparatus and (2) duration of whistles and chuts (Berryman, 1976) emitted in each of such areas. The seven areas, delimited according to distance from confinement cages and side, were: rear, middle (mother side), middle (female side), front (mother side) front (female side), mesh (mother

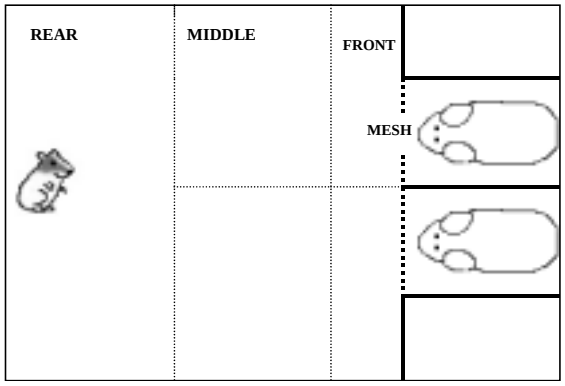


Figure 1. Upper view of the test box, showing areas (rear, middle, front and mesh), the initial position of the pup and of the confinement cages of females.

side) and mesh (female side). Mesh position was recorded whenever the pup got in touch with the wire mesh panel of one of the confinement cages (Figure 1).

Results

Trials in which the pups did not leave at all the rear part of the apparatus were not taken into account in the analysis, as they informed nothing about preference or recognition and could be due to a freezing reaction to test conditions. No significant difference was found among successive trials so measures were collapsed and analysis was applied to average scores of subjects.

Spatial position

Time spent by pups in the mother's side of the apparatus was not significantly different from time spent in the lactating female's side, whether at the middle (Wilcoxon, $p > 0.05$) or at the front (Wilcoxon, $p > 0.05$) of the apparatus. Pups spent, however, significantly more time near the mesh of their mother's confinement box than near the mesh of the other female's confinement box (Wilcoxon, $z = 3.421$, $p < 0.001$; Figure 2).

Vocalization

Chut and whistle rates were calculated as the ratio of time spent vocalizing/time spent in each part of the apparatus. As in the case of spatial position, average rates (combining data of three trials) were submitted to statistical analysis.

Chut and whistle scores did not differ significantly according to side of the apparatus (mother's side x lactating female's side), so we combined them across sides, at the mesh, at the front and at the middle parts of the apparatus, taking also into account rear scores. Differences both between whistle scores [Friedman, $\chi^2(18) = 34.432$, $p < 0.001$] and between chut scores [$\chi^2(19) = 30.916$, $p < 0.001$] at different sites were significant. Post hoc comparisions then performed using Wilcoxon test indicated the presence of a regular rear-mesh gradient in vocalization: whistles decreased while chuts increased from rear to mesh of the apparatus [*whistles*: rear x middle, $z(21) = 2.128$, $p < 0.05$; middle x front, $z(20) = 2.696$, $p < 0.01$; front x mesh, $z(18) = 2.438$, $p < 0.05$; *chuts*: rear x middle, $z(21) = 3.771$, $p < 0.001$; middle x front, $z(21) = 2.902$, $p < 0.01$; front x mesh, $z(19) = 3.139$, $p < 0.01$ (Figure 3).

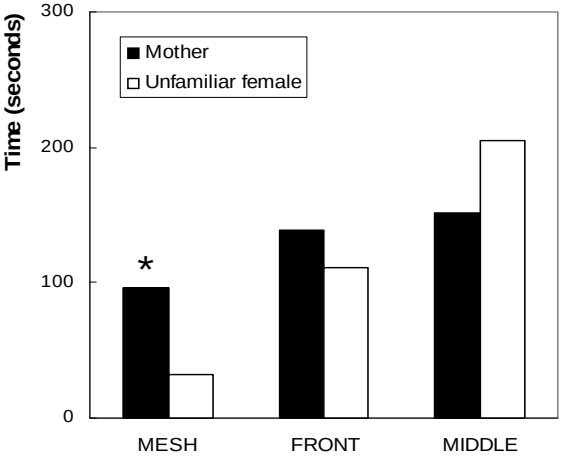
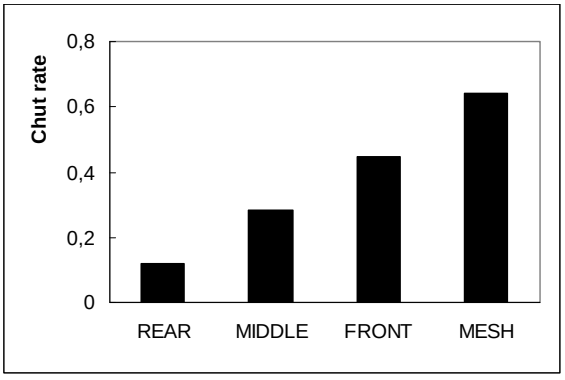


Figure 2. Mean time spent by pups in mother's side and unfamiliar female's side in the middle, front and mesh areas of the test box. The asterisk indicates a significant difference between scores.



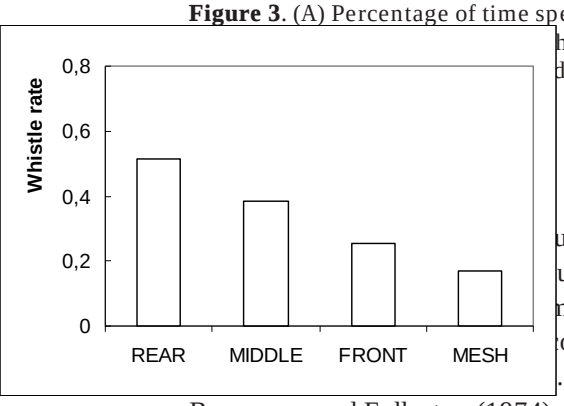


Figure 3. (A) Percentage of time spent by pups emit-
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. (1974) and in Berryman and Fullerton (1974) studies, in which mother recognition in guinea pigs was reported, members of the pair were free to interact with each other. In such case, as we previously argued, it is not possible to set apart the mother's from the pup's contribution to the establishment of closeness. Mothers in the present research could at most touch their pup's nose through the mesh.

It is however important to note that discrimination was only possible from a very short distance, actually when the young were near the mesh screen. At other sites of the apparatus, positioning was randomly distributed between the mother's and the lactating female's sides. This could mean that the sensory basis of mother discrimination is olfactory, as was also inferred by Porter et al. (1973). This hypothesis gives rise to questions, however. The first question is: why, once mothers' fur is so distinctively colored, shouldn't pups recognize it visually ? The second question is functional: could young manage to recover contact with their mothers by mere olfaction when, as might frequently occur in everyday guinea pigs foraging, they get apart from them? A search-and-bump olfatory search process seems quite inefficient when compared to visual guidance at a distance. In our experimental situation, the mesh might have obscured mothers: an experiment in which adult females are put behind clear transparent plexiglass screens could give information about the relevance of visual cues in mother recognition.

Successful recognition in our setup contrasts with results of the study by Porter et al. (1973), which indicated that guinea pig young couldn't distinguish between their mothers and lactating females in a two-choice, mesh-delimited situation. A possible reason for this negative outcome could be the relatively great distance between social stimuli. They were placed at opposite ends of a rectangular box so that crossing the box was necessary for the pup to alternate between one female and the other. In strange situations, as guinea pig infants are prone to freeze and eventually to stay near a conspecific for an extended period of time, such reactions could possibly have kept preferences from appearing. In our setup, the confinement boxes of mother and lactating female were close, making shuttling and choice easier.

The vocalization data collected – while showing that distress is reduced the more the pups get close to the females - do not reveal any differential effect of proximity to mother: whistles and chuts were as likely to be emitted at the mother's side as at the other female's side of the apparatus, even when pups got near the mesh screen. This result should not be taken as

indicating a lack of discrimination. Guinea pig adults are highly tolerant toward infants and the presence of an adult conspecific - mother, father, unfamiliar male - is sufficient to reduce whistle rate and probably to tranquilize pups isolated in a strange environment (Tokumaru, 1995). Level of plasma cortisol is also lowered by contact with mother or an unfamiliar female (Sachser, Dürschlag, and Hirzel, 1998). Tolerance is such that guinea pig pups can, with a certain frequency, be seen suckling from a familiar lactating female, even when mother is available (Fullerton et al. 1974). That the amount of whistle rate was, in the present experiment, kept at the same levels near both females is possibly a consequence of the highly gregarious way of life of guinea pigs.

The demonstration of mother recognition in domestic guinea pigs reestablishes the symmetry between mother and infant: both are involved in the maintaining of proximity and bonding.

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