PRECOPULATORY ULTRASONIC VOCALIZATIONS IN RATS: NOISE OR COMMUNICATION?

Eystein Hansen and Anders Ågmo
Department of Psychology, University of Tromsø, Norway

INTRODUCTION

Rats emit ultrasonic vocalizations in many contexts. For those interested in sexual behavior, the postejaculatory 22 kHz vocalizations as well as the precopulatory 50 kHz vocalizations are of particular interest. Although the circumstances under which vocalizations are emitted have been rather well characterized, very little is know about their possible effects on other individuals. Playback of the 22 kHz vocalizations has given conflicting results. This is also the case for the 50 kHz vocalizations emitted during the initial stages of copulatory interactions. Thus, at present it is not known whether high frequency vocalizations have a communicative function or not.

The simultaneous recording of ultrasonic vocalizations from both members of a pair of rats could perhaps give some clue as to their possible communicative function. In earlier studies one member of the pair had to be devocalized or anesthetized in order to determine the emitter. Such procedures probably altered the interaction between the subjects, making results difficult to interpret.

We now report some data from a preliminary study in which a two-channel ultrasonic recording system together with an especially designed experimental setup were employed. Video recordings of the animals were coordinated with the sound recording, making it possible to determine the behavior displayed during vocalizations both on the part of the emitter and of the receiver.

METHODS

We employ circular cages placed 2 cm apart with wire mesh openings in the lower part allowing the rat in one cage to hear, smell and see the subject in the other cage.

The inside cage walls are covered with sound absorbing material

Tests show that ultrasounds are transmitted from one cage to the lower part of the adjacent cage while normally not being recorded by the microphone located at the top of that cage.

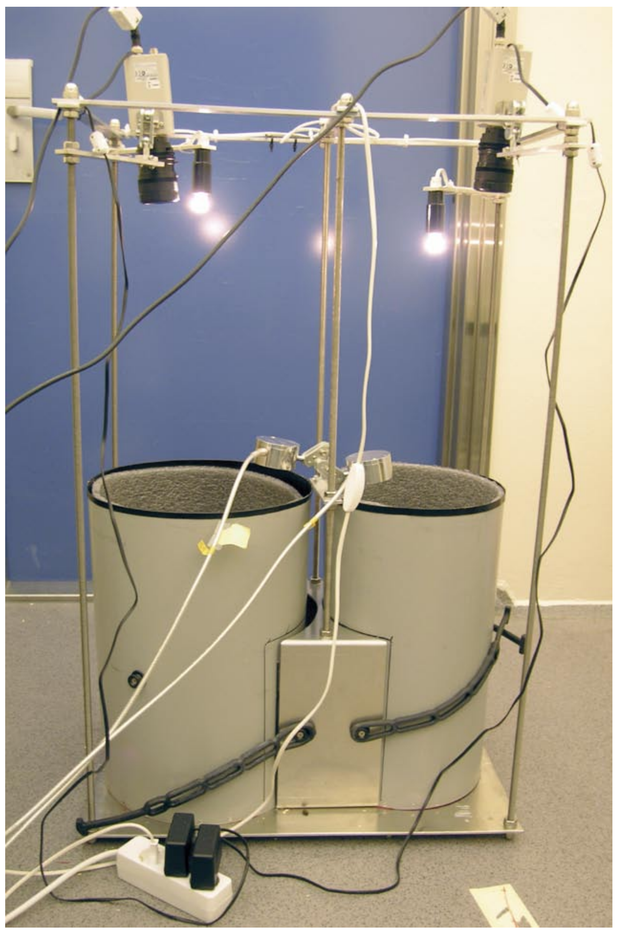


Figure 1. Photograph of animal cages and equipment

With a light source producing a light intensity of 8 lux at the bottom of the cage, the video cameras are able to record the animal's behavior. Time synchronization with ultrasound recordings allows for analysis of animal behavior during vocalizations.

Figure 2. Photograph showing inside of cage

Bedding on the bottom of the cage reduces noise and provides a familiar environment for the animal.

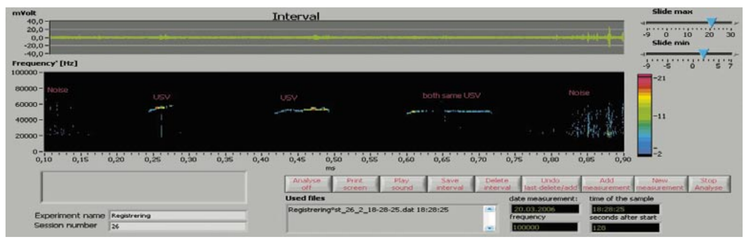


Figure 3. Illustrative sonogram. USV, ultrasonic vocalisation.

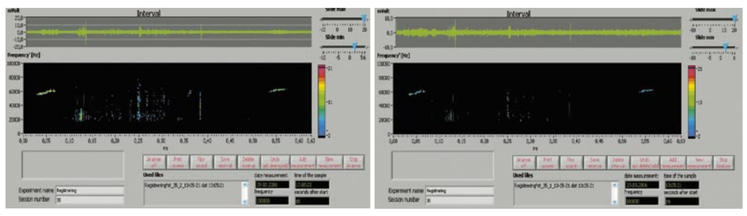
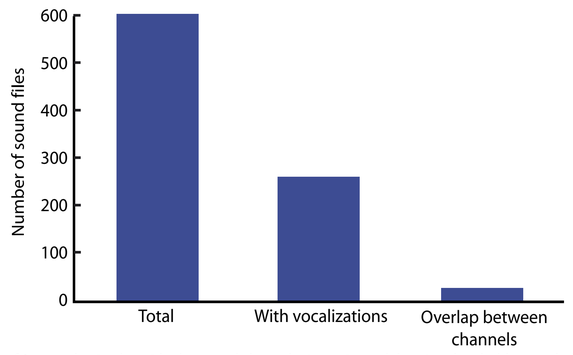
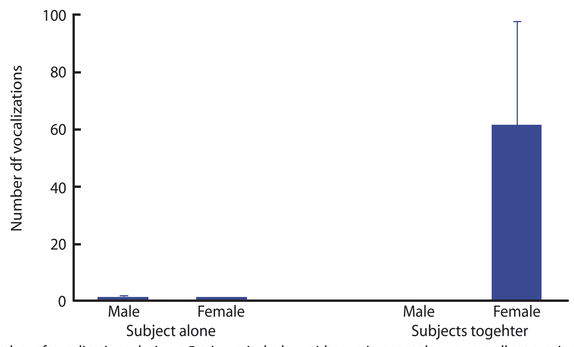


Figure 4. Sonograms comparing ultrasounds recorded simultaneously in both channels.

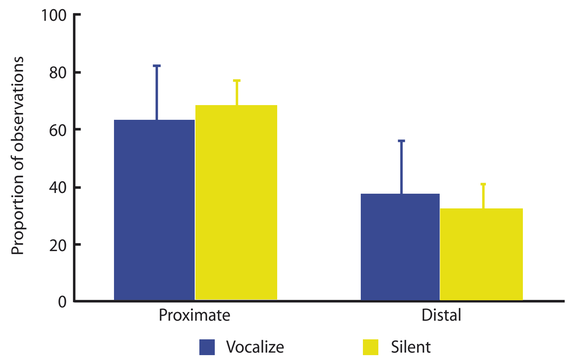
Even when a sound is recorded simultaneously in both channels it is possible to identify the source by comparing the intensity and exact time of recording.



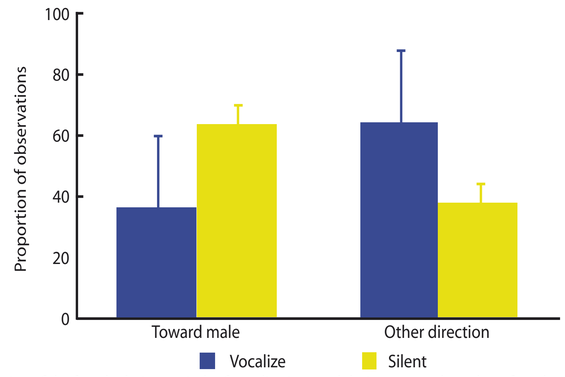
Total number of 1 second episodes with ultrasound above the intensity and duration thresholds recorded during tests. Of these episodes, 44 % contained only noise. Of the remaining episodes, ultrasound was recorded in both channels in 9 %.



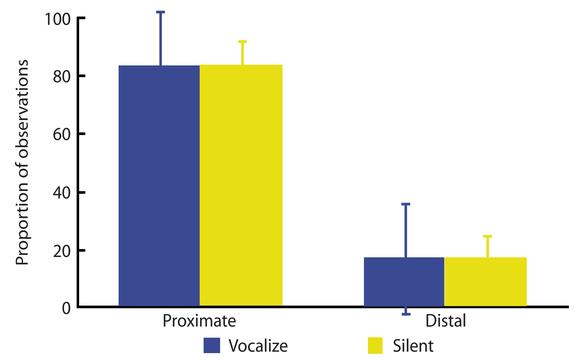
Left bars: Number of vocalizations during a 5 min period when either an intact male or a sexually receptive female were recorded with the adjacent cage empty. Right bars: Number of vocalizations during a 10 min period when either an intact male or a sexually receptive female were recorded when the adjacent cage contained a sexually receptive female or an intact male, respectively. Data are mean ± SEM.



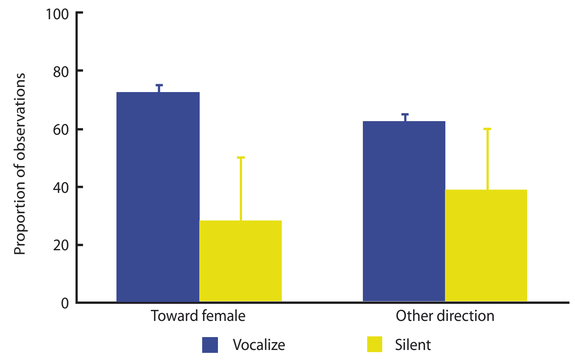
The position of the female during periods of vocalizations and during an equal number of randomly chosen periods of silence. Proximate means that the female had her 4 paws in the half of the cylinder close to the wire mesh separation while distal means that she had her 4 paws in the other half. Data are mean ± SEM.



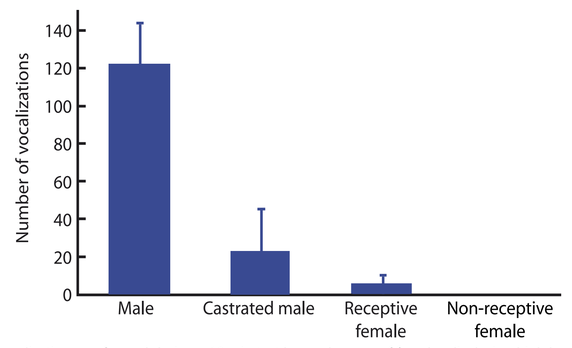
Head orientation of the female during periods of vocalizations and during an equal number of randomly chosen periods of silence. Data are mean ± SEM.



The position of the male during periods of female vocalizations and during an equal number of randomly chosen periods of silence. Proximate means that the male had his 4 paws in the half of the cylinder close to the wire mesh separation while distal means that he had his 4 paws in the other half. Data are mean ± SEM.



Head orientation of the male during periods of female vocalizations and during an equal number of randomly chosen periods of silence. Data are mean ± SEM



Number of vocalizations performed during a 10 min test by a subgroup of females displaying high levels of vocalizations in response to an intact male. In other tests, the intact male was replaced by a castrated male, another receptive female or a non-receptive female. Data are mean ± SEM.

CONCLUSIONS

With the present procedure it turned out to be possible to simultaneously record two adjacent animals and to identify the vocalizing subject. Although the animals were physically separated by a wire mesh, they could see, hear and smell each other. Nine percent of vocalizations were recorded in both compartments, but it was always possible to determine the animal of origin.

In pairs of a male and a sexually receptive female, it was basically the female who vocalized.

The behavior of the vocalizing female as well as that of the silent male was not clearly different between periods of vocalization and during an equal number of randomly chosen silent periods.

There were large interindividual differences, some females being silent and others emitting more than a 100 vocalizations during a 10 min test.

The stimulus control of vocalization was clear-cut in the vocalizing females. An intact male was a most efficient stimulus while a castrated male evoked a modest amount of vocalizations. Another sexually receptive female was less efficient than a castrated male, and a non-receptive female was inefficient.

It seems that a potential sexual partner evokes far more vocalizations than any other stimulus.

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