

The Impact Of Ultrasonic Noise On Lab Animal Welfare During Development

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Introduction

- Rats use ultrasonic vocalizations (USVs) to communicate:^{1,2}
 - Negative affect calls (~22 kHz)
 - Positive affect calls (~50 kHz)
 - Pup isolation calls (~40 kHz)
- Many electronic devices emit ultrasonic noise within the range of rat USVs.
- Previous work in our lab showed continuous exposure to ultrasonic noise increased anxious behaviors and physiological indicators of stress in adult rats.¹
- The present study aims to investigate the effect of perinatal ultrasonic noise exposure on rat dam and pup behavior and communication.

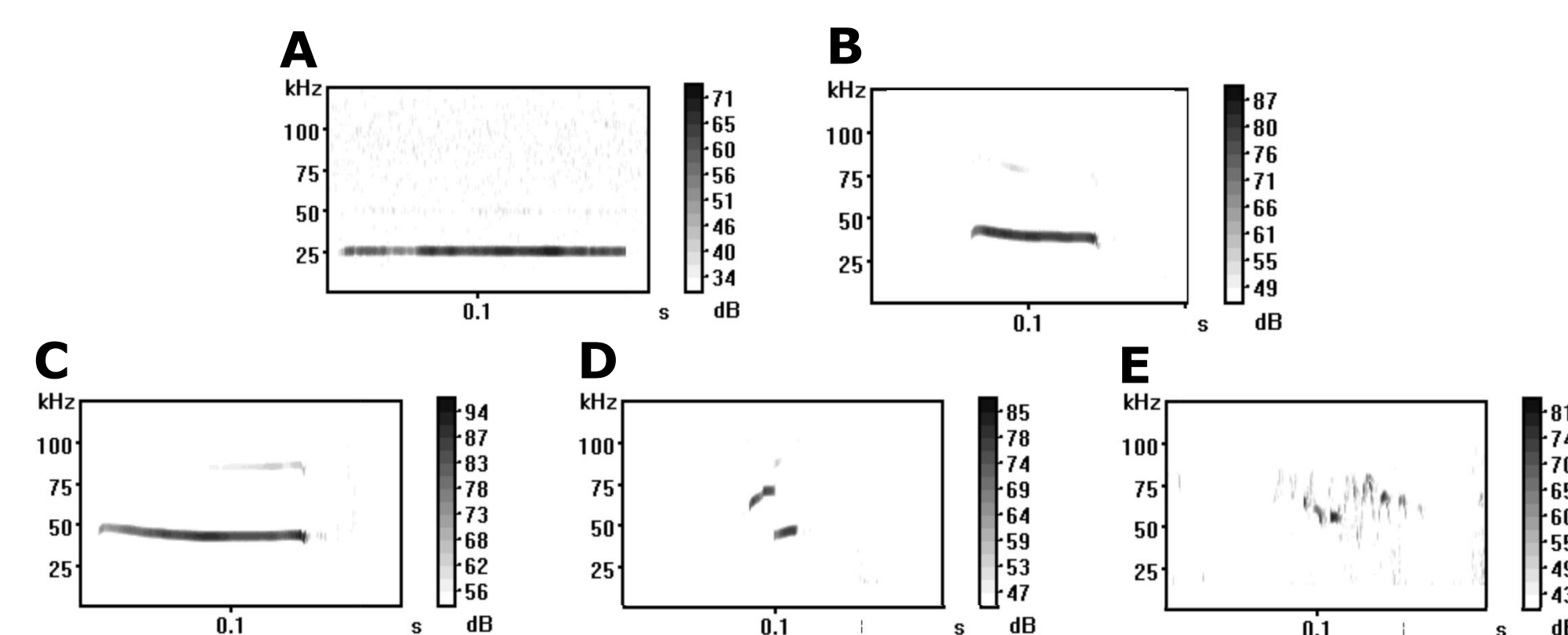


Figure 1. Various Types of USVs Calls. 22 kHz flat call associated with a negative affective state in adult rats (A), 40 kHz flat call associated with pups being isolated from their mother (B), 50 kHz flat call associated with a neutral affective state in adult rats (C), 50 kHz frequency modulated call associated with a positive affective state in adult rats (D), 50 kHz trill call associated with a heightened positive affective state in adult rats (E).

Methods

- Sprague Dawley rat dams were assigned to:
 - Ultrasound ($n = 5$)
 - No Noise ($n = 5$).
- Exposure to ultrasonic noise (40 kHz, 70 dB) occurred from embryonic day 16 (E16) to weaning on post-natal day 21 (PND21).

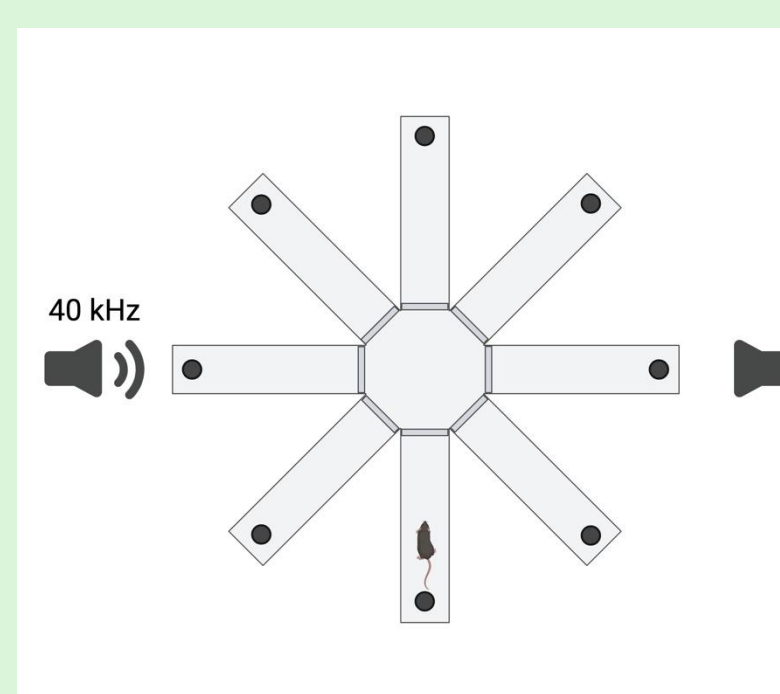


Figure 2. Depiction of USVs playback test setup on a radial arm maze.

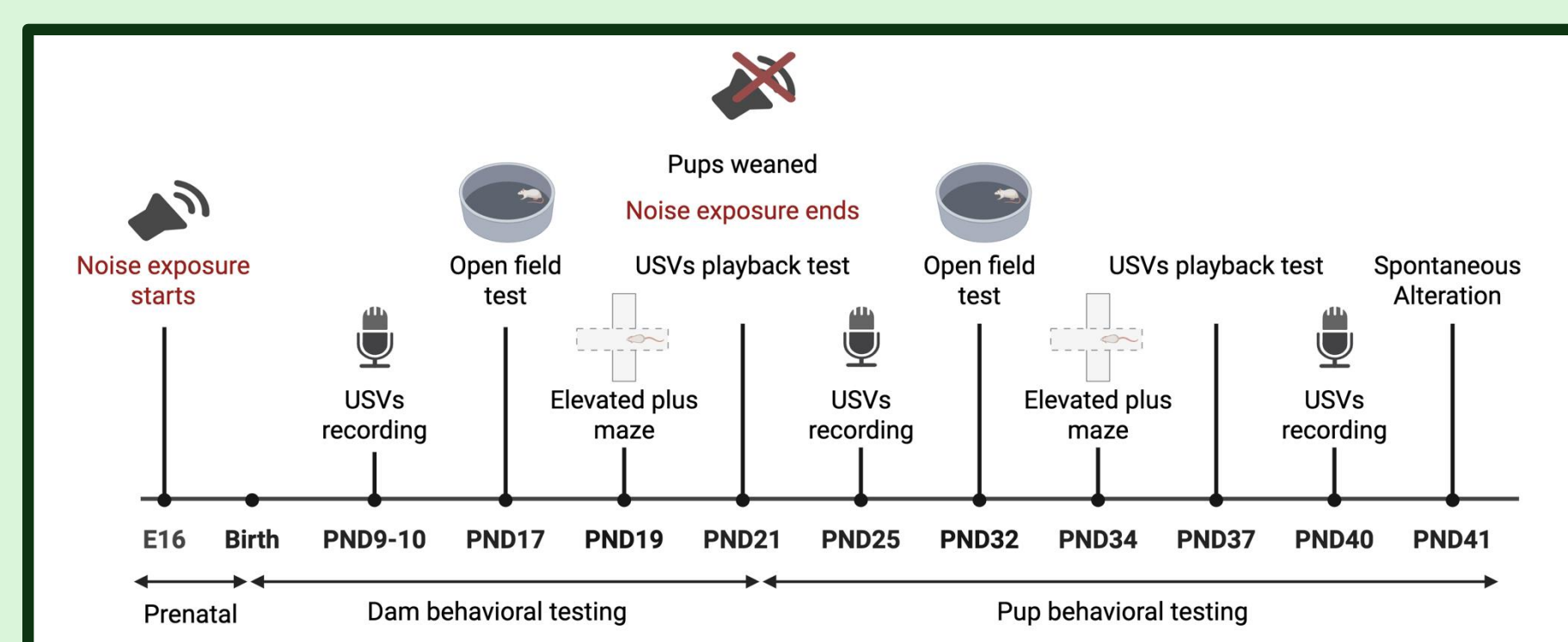


Figure 3. Study timeline.

Results

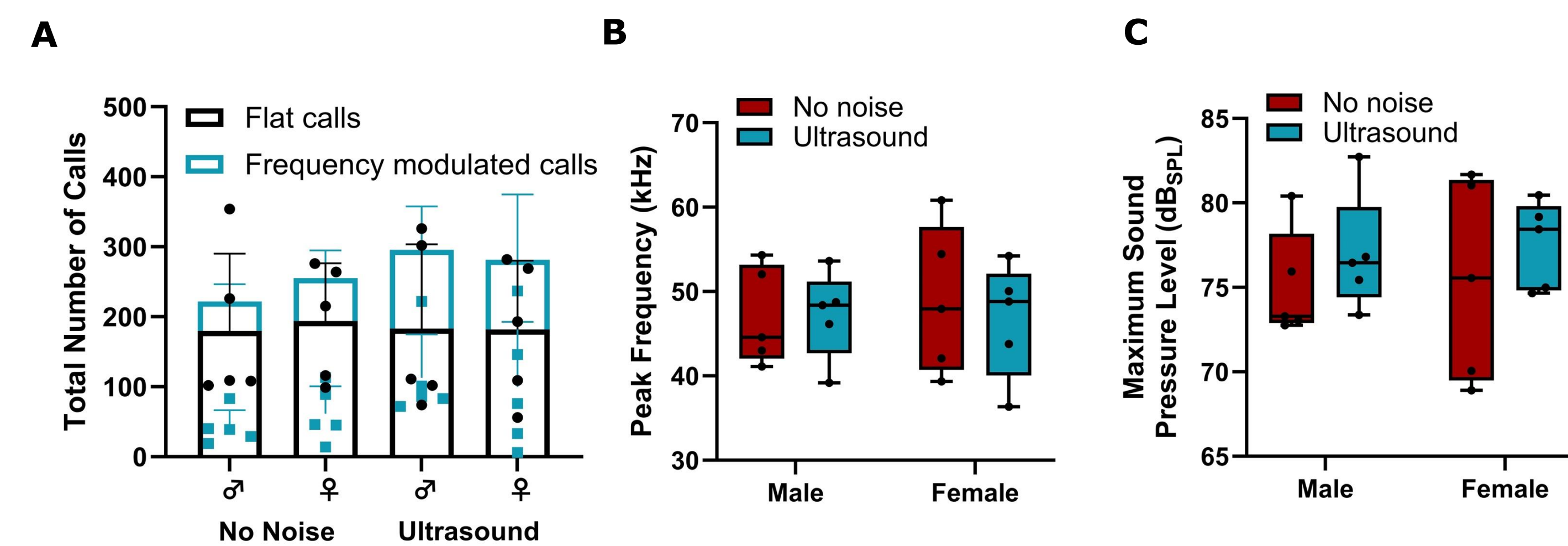


Figure 4. Isolation Induced USVs. Total number (A), peak frequency (B), and maximum sound pressure level (C) of calls emitted by pups isolated from home cage and mother on PND10.

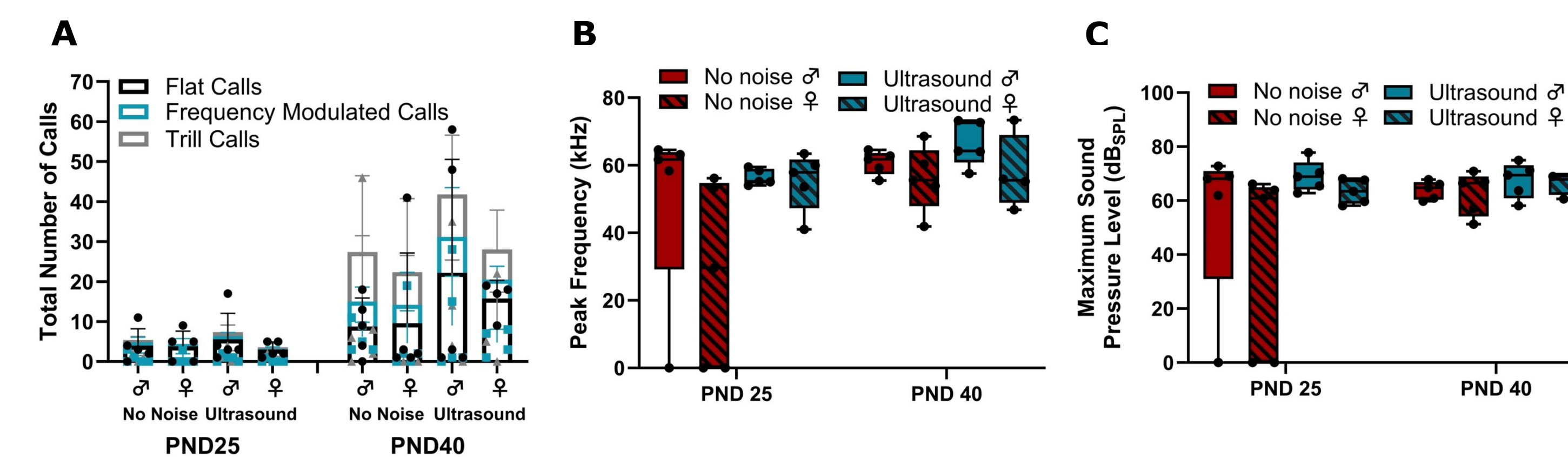


Figure 5. Pup Home Cage USVs. Total number (A), peak frequency (B), and maximum sound pressure level (C) of calls emitted by male and female pups in their home cage on PND25 and PND40.

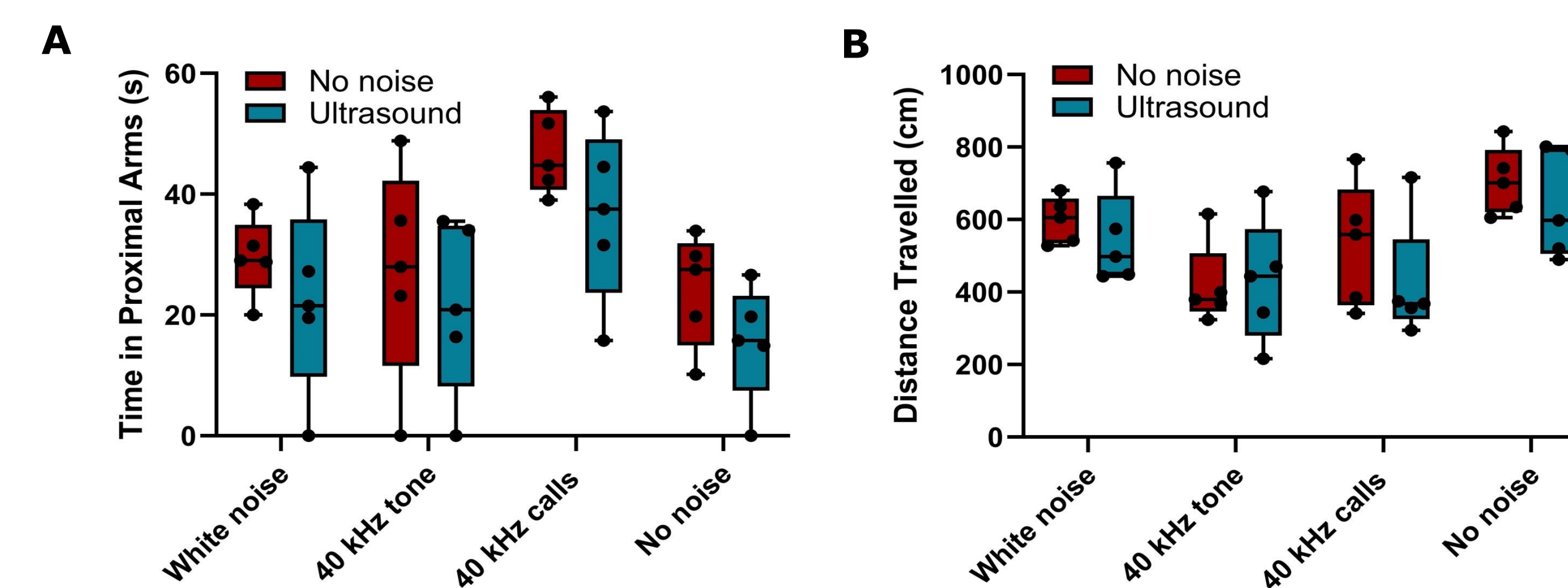


Figure 6. Dam USVs Playback Test. Time spent in radial arms proximal to the speaker (A) and total distance traveled in radial maze (B) by rat dams in the USVs playback test during white noise, a 40 kHz tone, a 40 kHz flat call, and no noise.

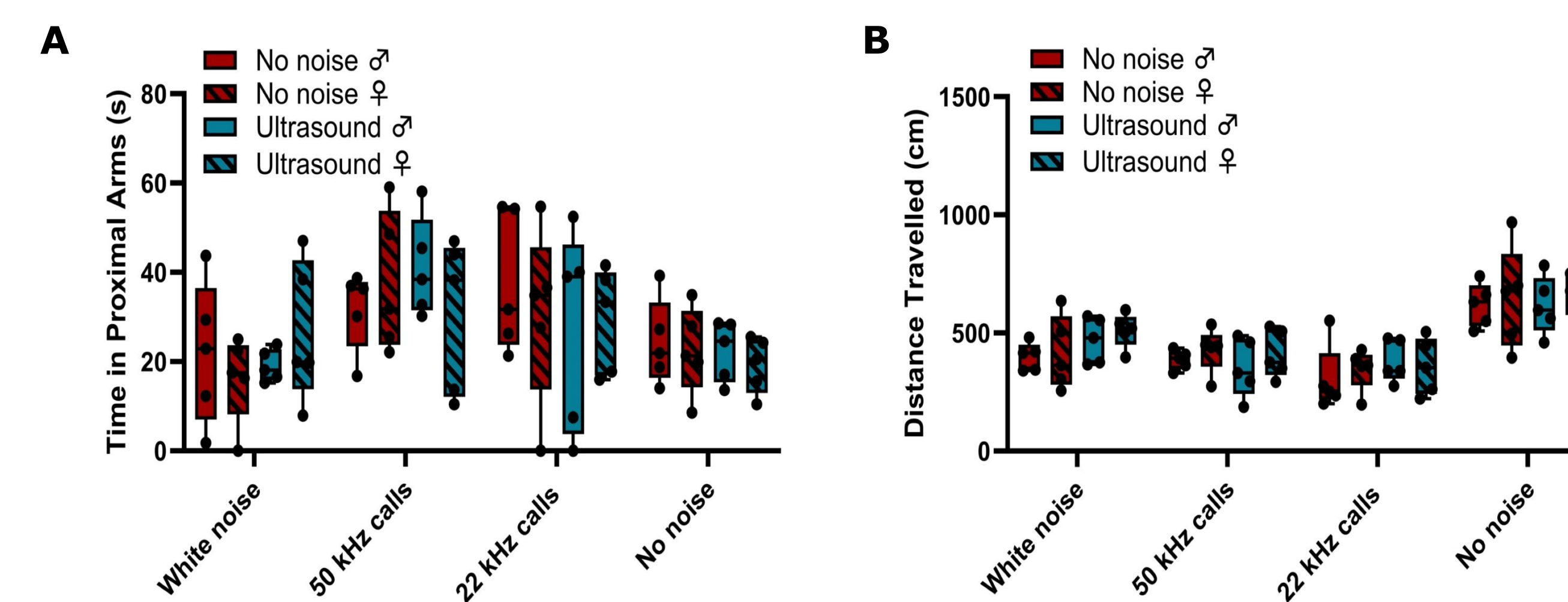


Figure 7. Pup USVs Playback Test. Time spent in radial arms proximal to the speaker (A) and total distance traveled in radial maze (B) by male and female rat pups in the USVs playback test during white noise, 50 kHz calls, 22 kHz calls, and no noise.

Conclusion

- This project aims to highlight overlooked environmental stressors as they relate to animal welfare.
- Preliminary data demonstrates that exposure to ultrasonic noise perinatally does not affect rat pup communication.
- While rats responded to USV playback as expected, additional cohorts will be necessary to clarify observed trends between the ultrasound and no noise groups.
- Upcoming analysis of data from additional behavioral and physiological parameters will further clarify the effects of environmental ultrasonic noise exposure.
- The study of additional cohorts is currently underway.

Acknowledgements

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