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COMMENTARIES

Noise Exposure, Music, and Animals in the Laboratory: A Commentary Based on Laboratory Animal Refinement and Enrichment Forum (LAREF) Discussions

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The effects of noise, in general, and music, in particular, on the behavior and welfare of animals in the laboratory deserve a great deal of empirical study. However, many laboratories must develop their current practices on the basis of sparse and conflicting data. With this commentary we seek to establish some of the factors that should be taken into account in deciding how to deal with sources of uncontrolled or deliberate sound and, specifically, in determining whether to play music in the laboratory. Views differ, however, the balance of evidence supports the use of quiet music during nonhuman animals' active periods, if this practice is introduced with an awareness of the risks to welfare and research.

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All nonhuman animals live under conditions determined not only by their immediate housing environments but also by the full range and acuity of their senses. Many animals in the laboratory, such as rodents, have very sensitive auditory pathways and produce vocalizations well beyond the range of human hearing. Animals in the laboratory may be more reactive than we realize to auditory stressors, many of which would not be disturbing or even perceptible to humans. However, sound may also provide an additional avenue for environmental enrichment.

NOISE

Uncontrolled Acute Loud Noise

Many laboratories have found that nearby construction or building maintenance has produced a downturn in breeding success or noticeable disturbance of their animals. Other loud and unpredictable sounds, such as sirens, fireworks, street races, or even missiles, can compromise animals' welfare.

When a potential auditory stressor is anticipated, events susceptible to disruption should be rescheduled, including the collection of data that might be invalidated by the use of highly stressed subjects.

An effective animal management plan should include both insulating against noise and increasing animals' feelings of security. Laboratories should soundproof animal rooms. When this is not sufficient, animals should be offered secure shelter (nesting material and hideaway areas), reassurance (housing in a familiar group), or stability (minimized disruption to daily schedules and care staff).

It may be helpful, especially for primates, to have human staff present in the room during the auditory event. Because loud noise is stressful, other sources of stress or increased sensitivity should be rescheduled so they do not occur at the same time. This might include pregnancy/nursing, experimental events, and mixing or moving between rooms. If animals need to be moved to a room that is quieter, or if construction displaces them, this move should be accomplished well in advance of the noise event, giving the animals time to adjust to their new surroundings.

Given the paucity of empirical data, it would be useful if animals' responses to noise stress were assessed. Casual observations suggest that unpredictable noise within the laboratory can increase the prevalence of coping mechanisms such as stereotypy within primates. Even if data collection is not possible, it is certainly a time to keep a close eye on your animals.

It may be possible to desensitize animals to upcoming noise either by gradually introducing similar recorded sounds, set at increasing volumes before the onset of the uncontrolled exposure, or by using a system of positive association to ensure that pleasurable experiences occur at a time that otherwise could be considered stressful.

Uncontrolled Chronic Loud Noise

Chronic sources of sound in the laboratory may include ventilation, building noise, animal noise, and human noise. Constant sound such as ventilation, in combination with cage and room partitions, may also prevent other sounds from reaching animals. Laboratory management must consider infra- and ultrasound components of all these sounds, decide which of these are desirable (conspecific communications, sounds that allow animals to anticipate events such as human handling) and which should be attenuated (distress calls, sudden incomprehensible sounds).

The desirable nature of some sounds must be appreciated rather than eradicated in an attempt to produce complete silence. For example, it is clearly desirable for a sow to be able to call her piglets to suckle; however, fan noise is often loud enough to disrupt this communication. Animals in isolation might also benefit from auditory contact with conspecifics, unless the calls they hear indicate distress.

Laboratories housing animals who are sensitive to a wide range of frequencies would benefit from having equipment capable of receiving and recording ultrasound, preferably over extended periods, and intense or chronic sources of ultrasound and vibration (e.g., rack-mounted ventilation motors) should be identified and minimized.

MUSIC

Music may have the benefits of masking sudden, artificial noises that are potentially stressful to the animal and breaking silence or a monotonous auditory environment known to affect the development of normal cognitive abilities. It may even be used as a predictable indicator of a positive event and reduce overall responsiveness to negative noise events.

Very few studies of the effects of music on animals have used thorough controls. In no case can the melodic content of the music be identified as the effective feature, although some studies show that animals react differently to music and other sounds, such as static (Kettelkamp-Ladd, 1993). It has been repeatedly demonstrated that nonmusical sound alone may have a beneficial effect on animals. For example, white noise appeared to render macaques calmer during blood collection (Kawakami, Tomonaga, & Suzuki, 2002) and to reduce the amount and intensity of barking in laboratory-housed dogs (Kilcullen-Steiner & Mitchell, 2001).

Music may sometimes act as a stressor. For example, both classical music and random noise events (aircraft noises) had a marked, negative effect on fearfulness in laying hens compared with normal barn noises (Campo, Gil, & Dávila, 2005). Loud radio has the potential to create stress that may reflect a negative response, such as the salivary cortisol response of marmosets to radio music at 70- to 80-db

sound (Pines, Kaplan, & Rogers, 2004) and blood glucose increase in dogs to 80-db sound (Treptow, 1966).

Thus, the introduction of music to a laboratory environment could have unforeseen negative effects. Care must be taken to avoid any animal being exposed to excessive volume. Music should be played not above a conversational level and only during the animals' active periods: If background noise is low, a conversational level should be around 60 db. One way to determine whether animals enjoy the music and when they want to hear it would be to allow them to play it "on demand" by pressing a simple panel or lever (Borchgrevink, 1986; Noval & Drewsen, 1989).

Potential adverse effects should be identified and watched for because music is typically a diffuse medium, and animals may have difficulty avoiding it or communicating any distress it causes. Given the natural prey status of many laboratory animals, evidence of stress or inability to manage sound stressors may not become evident until the animals are pushed beyond their ability to cope. Therefore, many stress responses may be subtle in response to low-level music.

If music is provided, it should be provided equally to all subjects within a study and mentioned in the Method section of publications. Even so, music must be seen as representing a potentially confounding variable. Many productive laboratories play music to their animals, suggesting that this practice may be followed without negative research outcomes.

All staff and researchers should be aware of music introduction, and there should be a period of observation to determine any effects on research. Insufficient auditory stimulation is also a confounding variable, albeit one we are less likely to note.

It may be important to consider the potential benefits of music to all groups, including humans, within the laboratory. Music may be seen as a potential confound by researchers, but it can be very important for animal technicians, who often spend very long hours in the animal housing rooms. The presence of music may significantly improve their well-being during the workday and aid in retaining experienced personnel in technical posts. It may also have a relaxing effect on the technicians, leading to lower levels of stress for the animals in their care.

When music types are compared, a range of species seem more relaxed with classical music, compared with pop or heavy metal. Wells, Graham, and Hepper (2002) discussed dogs and their musical preferences. Howell, Schwandt, Fritz, Roeder, and Nelson (2002) wrote of chimpanzees and their preference for soft, vocal music. Animals such as rats have been shown to have specific musical preferences that lean toward complex and melodic music, such as Mozart over Schonberg (Cross, Halcomb, & Matter, 1967). The apparent benefits of classical music on animals may conflict with the preferences of human workers. In this case, "easy listening" music or personal stereos may represent a workable compromise.

Finally, it must be considered that music might sound very different to animals who are sensitive to different sound frequencies or likely to find even volumes be-

low 60 db aversive. The introduction of music must be carried out with an acute awareness of species-specific perceptions and adherence to clear, predetermined protocols and precautions, such as not installing equipment capable of loud volume or the production of excessive ultrasound or vibration.

AUDITORY ENRICHMENT

Music tends to be readily seized on because it is easy and cheap to provide and pleasant for human caretakers. Some attempts have been made to substitute naturalistic soundscapes from the animals' natural environment. A recent study of gorillas has suggested that naturalistic sounds generate trends in behavior that may be suggestive of relaxation, although classical music may have a greater effect (Wells, Coleman, & Challis, in press).

There are other alternatives to taped sounds as a source of auditory enrichment. Many enrichment devices produce sound when moved by the animals and can provide them with some control over their environment (Melo, 1999). Animal-controlled sounds have the advantage of being available on demand and a source of experience and learning through interaction. However, they typically use only simple sounds, such as bells, and so will not provide masking or complex auditory stimulation.

CONCLUSIONS

In general, noise that is intense or long lasting and meaningless should probably be avoided, but noise that is stimulating and complex, or noise that communicates nonstressful content, might be encouraged. Laboratories should have an ongoing process that monitors and attempts to optimize all perceptible qualities of the animals' environment. Music seems to be one acceptable method for managing the auditory environment in that it masks potential auditory stressors or introduces auditory stimulation. However, there is a pressing need for more research in this area to provide a more sound empirical basis for husbandry decisions relating to the auditory environment.

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