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Effects of music on behavior and physiological stress response of domestic cats in a veterinary clinic

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Abstract

Objectives Our objective was to determine if feline-specific music played in a veterinary clinical setting would promote lower cat stress scores (CSSs), lower mean handling scale scores (HSs) and reduced neutrophil:lymphocyte ratios (NLRs) in cats during physical examinations.

Methods Cats were exposed to one of three auditory stimuli tests – silence, classical music and cat-specific music – during three physical examinations 2 weeks apart. CSSs were recorded at pre- and post-auditory tests and during the examination period. The HSs were recorded at the physical examination period. The physiological stress was assessed via NLRs.

Results The pre-auditory test showed no difference in CSS between cats listening to silence, classical music and cat music. CSSs for post-auditory tests and examination periods were not significantly different between silence and classical music; however, CSSs were significantly decreased in cats listening to cat music vs silence and in cats listening to cat music vs classical music. HSs were not different in cats listening to silence vs classical music, but were significantly lower in cats listening to cat music vs silence and classical music. No difference was found in NLRs among all three auditory stimuli tests.

Conclusions and relevance Listening to cat-specific music prior to, and during, physical examination was associated with lower CSSs and lower HSs in cats, but had no effect on the physiological stress responses measured by NLRs. We conclude that cat-specific music may benefit cats by decreasing the stress levels and increasing the quality of care in veterinary clinical settings.

Keywords: Feline music; species-specific music; cat stress scores; CSS; handling score; HS; behavior

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Introduction

The use of music in human medicine has become increasingly popular. Several studies indicate that music can be used as an adjunct in many types of therapies. From improving motor and cognitive function in stroke patients to reducing fear and anxiety associated with examinations, diagnostic procedures such as positron emission tomography scans, surgeries, cancer treatment, coronary heart disease, mechanical ventilation and post-traumatic stress disorder, music has found a place in modern medicine.[1–5] Individual studies suggest that the need for anesthetics and analgesics, as well as recovery time and duration of hospitalization, may be reduced when music therapy is added to treatment protocols.[5]

The benefits music has shown in the human medical field has led to increased interest in how music affects animals. Stress related to changes in the environment and handling is well documented in domestic species, including dogs and cats. Studies have shown that stress in cats introduced to a novel environment could take upwards of 5 weeks to overcome.[6] Environmental

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modifications, not including music, are effective in decreasing undesirable stress behaviors in cats, including lower urinary tract signs, fearfulness, nervousness, respiratory signs and aggressive behavior.[7] Music, however, has been shown to be effective in reducing stress and eliciting calm behaviors in other species such as dogs and tamarins.[8–11] Dogs held in kennels vocalized less, had a decrease in the amount of nervous shaking, spent more time lying down and had increased parasympathetic responses, as noted by heart rate and respiratory rate changes while listening to classical music.[8,9] Kogan et al mention findings consistent with human studies in that music can reduce agitation, improve sleep and mood, and reduce stress and anxiety.[8] However, Bowman et al found that these positive effects on behavior may be limited owing to habituation of kenneled dogs to the classical music by the second day of listening to a classical soundtrack.[9] In 2017, Bowman et al concluded that providing alternative genres mixed with classical music playlists may combat habituation and increase the amount of time parasympathetic stimulation is elicited and calm behaviors are observed.[10] Calming behaviors in tamarins, which included decreased movement, orientation and social behavior, and increased foraging behavior, were noted in response to tamarin affiliation-based music, a specially written species-specific music.[11]

Music in the veterinary clinical setting has also been shown to reduce anxiety in dogs visiting veterinary hospitals. Engler and Bain report that client-owned dogs visiting veterinary hospitals were perceived by both the owner and clinician to have reduced anxiety when listening to classical music while waiting in examination rooms compared with the lobby waiting area without classical music played.[12] Owners were also more satisfied with visits when they waited in an examination room with classical music playing vs waiting in the lobby waiting area.[12] Owner satisfaction is important in both reducing anxiety for the client and animal, as well as increasing repeat visits by that client.

While substantial evidence has been shown that music can benefit animal welfare by decreasing anxiety and performance of stress-related behaviors, these effects did not carry over to the sedated patient.[13] Albright et al discovered that, while noise over 80 dB, which is similar to that found in a veterinary clinic, was detrimental to sedation and increased spontaneous behavior scores, music did not positively impact sedation.[13]

These findings beg the question whether music, specifically cat-specific music, can provide similar outcomes in cats. In fact, Snowdon and Teie recently concluded that cats listening to music in their homes prefer music that was specially made with cat vocalizations, with preferred tempos and with normal vocal frequencies as the primary considerations.[14] Cats responded to music positively by orienting and approaching speakers playing cat music more often and quicker than to speakers playing classical music.[14] The cat music played contained melodic lines based on affiliative vocalizations and rewarding sounds.[14] These melodies are interpreted as more likely to be effective if the goal is to calm an agitated cat.[14] The thought and musical design behind composing cat-specific music was based on the idea that the development of the emotional centers in the brain of the cat occur shortly after birth, during the nursing stage. Because purring and suckling sounds are common in this developmental stage, these sounds are layered into tempos and frequencies used in feline vocalization to create cat specific music.[15]

With the success of cat-specific music producing positive response behaviors in the home, the question arises whether the music can provide the same positive responses in the form of measurable stress relief in a veterinary setting. Stress during veterinary visits is common in domestic cats and can cause unwanted anxiety and frustration for both the veterinary professional and owner.[16] Reducing feline anxiety during veterinary visits could have great health benefits for domestic cats by not only reducing stress-related illnesses and behaviors, but also by allowing for a more pleasant veterinary visit for cats and their owners. More pleasant visits could potentially influence cat owners to visit the veterinarian with their cats more often.[17]

The purpose of this study is to show that music specifically composed for cats to reduce stress and anxiety in a veterinary clinic can promote calm behaviors. We hypothesize that cat-specific music will promote lower cat stress scores (CSSs), lower mean handling scores (HSs) and reduced physical stress responses during a physical examination via lower neutrophil:lymphocyte ratios (NLRs). To our knowledge, this is the first study on how cat-specific music can affect cats in a clinical setting.

Materials and methods

Animals

Clients from the community, faculty and students volunteered their cats for participation in the study. Twenty-five cats were screened for inclusion criteria. Cats of any breed, between the ages of 1 and 10 years, male or female, sterilized or intact, living indoor or outdoor were enrolled in the study at the Louisiana State University (LSU) School of Veterinary Medicine. Cats diagnosed with any chronic clinical illness (kidney disease, urinary tract infection, cystitis, degenerative joint disease, etc) or diagnosed with a health problem upon initial examination that could possibly affect their behavior were excluded from the study. The study was approved by the LSU Institutional Animal Care and Use Committee. All clients volunteered their cats for the study and provided written consent.

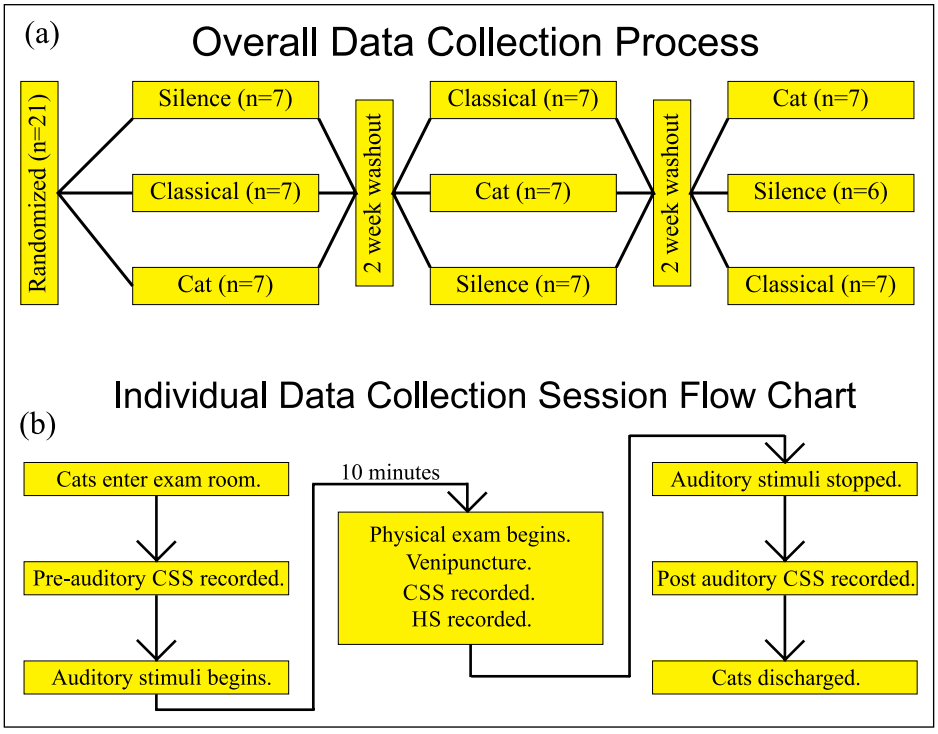

Figure 1 (a) Overall study design. (b) Individual data collection session flowchart. CSS = cat stress score; HS = handling scale score

Study design

A summary of the methods is illustrated in Figure 1. The study was conducted as a randomized, placebo-controlled, crossover trial. Cats that met the inclusion criteria were randomly assigned to one of three different auditory stimuli tests by use of a computer program (www.randomizer.org). The three different auditory stimuli tests were no music (silence), classical music (classical) or feline-specific music (cat).

A cat was allowed to listen to silence, classical or cat music upon entering the examination room at the LSU Veterinary Teaching Hospital for 10 mins prior to the start of the physical examination (acclimation period). After that, two veterinary students proficient in physical examination and venipuncture and trained in the study's methodology performed full physical examinations, including turgor test, mucous membrane examination, capillary refill time, oral examination, body condition assessment, abdominal palpation, pulse and heart rate, respiratory rate, cardiopulmonary auscultation and rectal temperature, all while the auditory stimuli continued. Cats were removed from their carriers for each physical examination and venipuncture. One student was responsible for performing the physical examination in the same order each time and restraint during venipuncture while the other student was responsible for venipuncture and restraint during physical examination for each patient. Clients were not allowed in the room while the physical examination occurred, to minimize other stimuli that may affect the cat's behavior. After the physical examination, venipuncture of the medial saphenous vein was performed to obtain 0.5–1 ml of blood for the NLR to test for physiological stress responses.[18] Cats were then discharged from the hospital.

Two weeks after the initial session, cats were returned to the hospital for a different auditory stimuli test (first crossover) that they had not had in the first session. After the 10 min acclimation period, a physical examination and complete blood count were obtained as in the first session. The third session was conducted 2 weeks after the second session. Again, cats were exposed to a different auditory stimuli test (second crossover) that they had not received in the first and second sessions. After the 10 min acclimation period, physical examinations and complete blood counts were obtained as in the first two sessions. After obtaining blood in the third session, the study ended.

Each session was video-recorded and had audio removed, allowing for a blind observer to score each cat's behavioral responses using a CSS and an HS. For each cat, CSSs were evaluated upon entering the examination room and before the cat was removed from the carrier. This first measure was evaluated before any auditory stimuli began (pre-auditory test). Once the auditory stimuli began and the 10 min acclimation period was complete, the physical examination began. CSSs were then measured again during the physical examination (exam period) with the auditory stimuli

continuing throughout. CSS values grade the cat on a scale from 1 to 7, based on stress-related behaviors, as described in Kessler and Turner (see Table 1 in the supplementary material).[19] After the physical examination and venipuncture were complete and the cat was placed back in the carrier, the auditory stimuli stopped and the last CSSs were taken (post-auditory test). Cats were also assigned an HS, which scored the cat based on its reaction to the handler, as described in Zeiler et al (see Table 2 in the supplementary material).[20] HSs were assessed during each physical examination period for every cat while music was played.

Music

The classical music (classical) selected for use in the study was 'Élégie' (Hyperion Records), written by Gabriel Fauré, performed by Alban Gerhardt and Cecile Licad, and produced by Rachel Smith in association with Hyperion Records. 'Élégie' is similar to many other musical pieces considered pleasing to the human ear in that it has a beat similar to the resting pulse rate of humans (66 beats per min) and contains frequencies similar to the human vocal range.[14] The feline-specific music (cat) selected for use in the study was 'Scooter Bere's Aria' composed, performed and produced by David Teie and sold by Universal Records UK. This music contains purrs and suckling sounds made to sound like real cats and frequencies similar to cat vocal ranges, which are two octaves higher than human vocal ranges (55–200 Hz) and were found to be pleasing to cats.[14] These elements were presented concurrently making it more appropriate and effective for clinical use (short visits) compared to cycling the elements as performed previously in home environments.

Statistical analysis

A Friedman test was used to compare CSSs over the three groups for each pre-examination, examination and post-examination, as well as to compare the overall HS. A two-tailed Wilcoxon signed rank test with Bonferroni adjustment was performed as a post-hoc test on those data that were significant. A one-way mixed ANOVA was used to compare the NLRs between the three groups. Order effect was initially considered as a fixed effect in the mixed ANOVA and later removed from the final model as a result of its insignificance. A P value <0.05 was deemed significant.

Results

Animals

Twenty-five cats were screened for this study. Four cats were excluded prior to any data collection because they were older than 10 years of age. Twenty-one cats that met the inclusion criteria were enrolled. One cat was dropped after the second examination per client request. Twenty cats completed all three sessions required for the study. There were 12 (60%) males and 8 (40%) females (mean ± SD age 5.2 ± 1.9 years; mean ± SD body weight 4.8 ± 1.2 kg, median body condition score 5.95 [range 5–7], mean ± SD rectal temperature [RT] 38.3 ± 0.5°C (101.9 ± 0.9°F), mean ± SD heart rate [HR] was 181.8 ± 20.4 beats/min and mean ± SD respiratory rate [RR] was 60.4 ± 18.8 breaths/min). Physical examination data, including HR, RR and RT comparisons were all within normal ranges accepted for healthy cats. These data showed no significant differences among groups ($P = 0.92$). There were no significant differences found in age, sex, lifestyle (indoor vs outdoor), reproductive status (neutered vs intact) and breed among groups ($P = 0.9$).

CSS and HS

No order effect was found to occur in any group when considering CSSs during pre-auditory test periods, examination periods or post-auditory test periods ($P > 0.05$ for all groups during all periods). No significant differences were found in CSSs according to a Friedman test between the three groups of cats during the pre-auditory test period ($P = 0.56$); however, significant differences were found in CSSs during both the examination period and post-auditory test period ($P < 0.0001$ examination and post-auditory). After applying the Bonferroni adjustment for pairwise comparisons (significance was determined when $P < 0.02$ after adjustment), no difference was found in the CSSs of cats listening to silence vs classical music during the examination ($P = 0.02$) or post-auditory test period ($P = 0.02$). CSSs were significantly lower in cats listening to cat music when compared with silence and classical music during both of these periods (Figures 2 and 3).

No order effect was found to occur during pre-auditory test periods, examination periods or post-auditory test periods when considering HS ($P > 0.05$ for all groups during all periods). The HSs during the examination period for cats listening to silence, classical and cat music showed significant differences using a Friedman test ($P < 0.0001$; Figure 4). A Wilcoxon signed rank test with Bonferroni adjustment post-hoc test compared the HSs between the groups (significance was determined when $P < 0.02$ after adjustment). No differences in HSs were found between cats listening to silence and cats listening to classical music ($P = 0.78$). HSs were significantly lower in cats listening to cat music when compared with cats listening to silence (Figure 4). HSs were also significantly lower in cats listening to cat music when compared with cats listening to classical music (Figure 4).

No order effect was found to occur when comparing NLRs between groups ($P = 0.33$). A one-way mixed ANOVA was used to compare the NLRs between cats listening to silence, classical and cat music. No

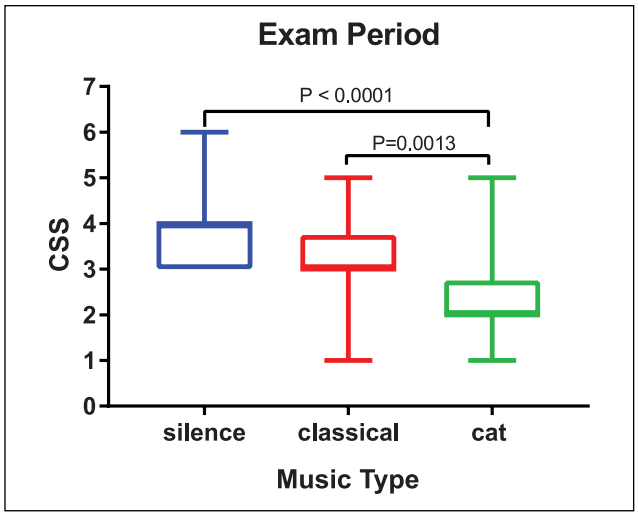

Figure 2 Cat stress scores (CSSs) between the three auditory stimuli during the examination period

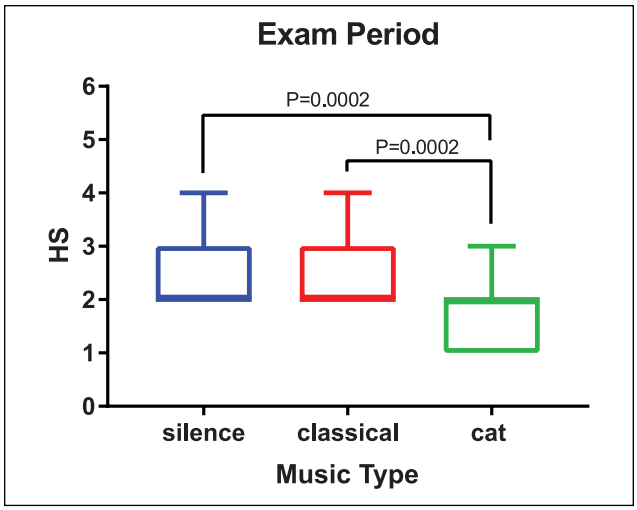

Figure 4 Cat handling scores (HSs) between the three auditory stimuli during the examination period

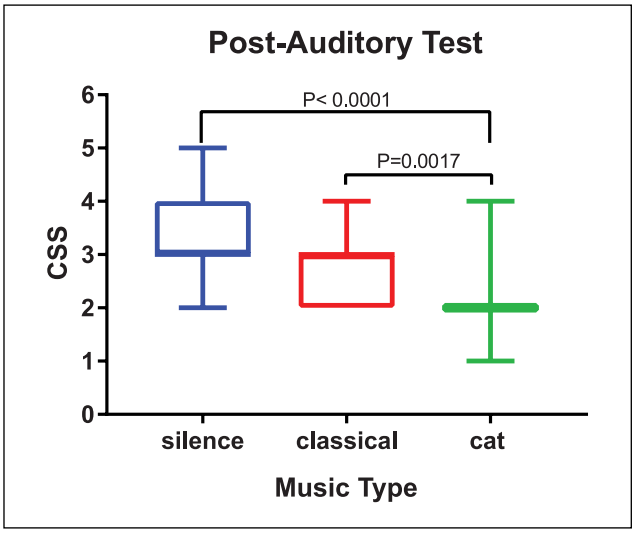

Figure 3 Cat stress scores (CSSs) between the three auditory stimuli in the post-auditory period

difference was found in the NLR between the three groups ($P = 0.8$).

Discussion

The goal of this study was to determine if feline-specific music could aid in reducing behavioral and physiological stress signs in cats visiting the veterinary clinic for a wellness examination. CSSs were not significantly different when comparing cat behaviors between the silence, classical music and cat music treatments during the pre-auditory test period. This should be expected as travel to the veterinary clinic and initial introduction to a novel environment are stressful events for cats.[7,21] Physical examinations were not performed on cats until they were exposed to the auditory stimuli for 10 mins. Time was allowed for the cats to listen to and adjust to the auditory stimuli. The examination period, however, did show significantly lower CSSs when cats listened to cat music compared with listening to silence or classical music (Figure 2). CSSs may vary after this pre-auditory period, but prior to the examination period. This should be the topic of further study to determine how long cats need to listen to feline-specific music to begin eliciting behaviors worthy of the lower CSS seen 10 mins later during the examination period. CSSs were also significantly lower in cats listening to cat music when compared with silence and classical music in the post-auditory test period (Figure 3).

Our findings during the post-auditory tests and examination periods support the idea that cats respond more positively to music made specifically for them and suggest that tranquil behaviors can be achieved in a veterinary clinical setting with the introduction of cat-specific music. Our results also suggest that this would not be the case for classical music or silence. There were no differences in CSS between silence and classical music in either the post-auditory test or examination periods (Figures 2 and 3). This suggests that the specific sounds, frequencies and rhythms of cat music were responsible for the low CSSs seen in cats listening to cat music.

Cat HSs were significantly lower in cats listening to cat music than those listening to either silence or classical music (Figure 4). Our findings are similar to that of Zeiler et al in that access to environmental enrichment may have been a factor in lower HSs in cats staying in hospital short term.[20] Again, it was the cat music stimuli specifically that was responsible for lower HSs. The classical music when compared with the silence control did not significantly lower these scores. Our results suggest that a cat displaying less anxiety while listening to cat-specific music is more comfortable in its surroundings

and is easier to handle. Easier handling can allow veterinarians and staff to conduct better physical examinations and acquire more accurate vitals.[22] The ease of handling may also provide comfort to the client and boost their confidence in the veterinary team, and would, in turn, lead to better owner compliance when scheduling veterinary visits.[17,22]

The NLRs were compared between the three stimuli tests to determine if music had an influence on physiological stress in cats. Our results showed no significant differences in the NLR between the three stimuli tests. Stress can cause an increase in cortisol levels in the blood. Increasing glucocorticoid levels in the blood of cats redistributes lymphocytes from the blood to the interstitium and causes an increase in circulating neutrophils.[23] Therefore, higher ratios of neutrophils to lymphocytes were expected in cats listening to no music and classical music when compared with cat music. However, our results did not show this. A normal NLR should be about 1.71 in healthy cats.[23] NLRs for cats in our study were just above this average, with cats listening to no music having the highest average NLR at 3.26. This could be the result of increased epinephrine or increased glucocorticoid levels causing an increased NLR during the travel period prior to any auditory stimuli being offered. Stella et al report that blood profiles should return to normal within 3 h of an acute stress event.[23] Therefore, our 20 min auditory stimuli test and examination period would not have been long enough to allow music to have an effect on the blood profiles of our acutely stressed cats.

Measuring these NLRs in response to different auditory stimuli over an extended period may better assess how music affects physiological stress responses in cats. Other ways to measure stress responses in cats, such as fecal cortisol levels or urine cortisol levels, may also provide a more accurate measurement of glucocorticoid levels in response to acute stress in the cat and should be tested.[23,24] HR variability has been used to measure both physical and emotional stress. In humans, HR variability was found to be lower in children and adolescents with functional somatic symptoms that occur when the body responds to physical or emotional stress.[25] While there has not been any testing in cats, this could be a potential way to measure stress during veterinary visits, and even prior to the visit, if the stress of wearing a monitor could be controlled for.

Conclusions

The study has shown that cat-specific music can significantly lower stress-related behaviors in cats visiting the veterinary clinic for wellness examinations. Adding cat-specific music to veterinary offices as environmental enrichment could provide great value to the cat's welfare in the clinic, to the client's comfort and confidence in the veterinary team and the veterinary team's ability to accurately assess the patient. Further studies should evaluate how cat-specific music can affect cats stressed over longer hospitalization periods and how these effects contribute to changes in physiological stress responses such as NLRs, fecal and urine glucocorticoid levels, and HR variability in cats.

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Supplementary material The following files are available online:

Supplementary Table 1: Behavior and posture descriptions used to evaluate cat stress scores.

Supplementary Table 2: Behavioral descriptions used to evaluate handling scores.

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