The Felid Purr: A bio-mechanical healing mechanism

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Scientific abstract Cat Purr Analysis

Partial reference list

Notice to readers. This paper is not designed to give veterinary or medical advice.

Forty-seven felids were recorded including cheetahs, ocelots, pumas, domestic cats, and servals. A Sony TCD-D8 Digital Audio Recorder (DAT) and Statham Radio microphones recorded the purrs. FFTs and spectrographs were performed using National Instrument's Polynesia. An accelerometer was also used to measure domestic cat purrs. Then we analyzed hours and hours and hours of purrs. This is what we concluded.

All smaller felids, including the domestic cat, caracal, serval, puma, ocelot, and even some large cats such as lions and cheetah purr. Since the 1970's no one has pursued research into the 3000-year-old question, "Why do cats purr?" Perhaps it is because, one, we didn't have the knowledge we have now, and two, it was simply easier to assume that cats purr when they are content, which cannot be argued-they do purr when they are content. However, they also purr when frightened, severly injured, giving birth and even while dying. Because of this, the contentment hypothesis clearly cannot be the only reason cats' purr:

(1) A vocalization is used to display a particular emotion or physiological state. This enables an individual in society or pack to be able to express themselves. As any cat owner knows well, there are different "meows" for different emotions. A cat owner knows the difference between their cat's "fearful hiss", "food meow", and "let me oooouuutttt!!!" This cannot be applied to the purr however. Cats purr even when they give birth and when severely injured in a barren cage at the veterinarian. There are cases of cats purring when they are in grave physiological or psychological stress, as well as when they sit on your lap. Therefore, purring really cannot be considered a vocalization, as the purr is produced under differing emotions or physiological states. As an example, a cat hissing when he/she was happy and when he/she was scared, would confuse the rest of the cat's companions and probably would lead to him/her being ostracized.

(2) Natural selection ensures that a particular trait be advantageous to an animal. Admittedly, there is some benefit obtained from purring to ones' self or to kittens, (a

sort of kitty lullaby if you wish). Yet, there does not appear to be a strong 'survival' advantage to this behavior, unless, of course, you wish to constantly display submission. For the purr to exist in different cat species over time, geographical isolation etc. there would likely have to be something very important (survival mechanism) about the purr. There is also would have to be a very good reason for energy expenditure (in this case creation of the purr), when one is physically stressed or ill. The vibration of the cat's diaphragm, which with the larynx, creates the purr, requires energy. If an animal is injured, they would not use this energy unless it was beneficial to their survival. When was the last time you heard someone singing, or humming to themselves (before pain drugs, and they weren't on any when they came in*)* when they were in the emergency room with a broken leg? The purr has to be somehow involved with survival.

Old wives' tales usually have a grain of truth behind them, and most people have heard of a cat's "nine lives." There is also an old veterinary adage still repeated in veterinary schools which states, "If you put a cat and a bunch of broken bones in the same room, the bones will heal." Any veterinary orthopedic surgeon will tell you how relatively easy it is to mend broken cat bones compared with dog bones which take much more effort to fix, and take longer to heal. There is excellent documentation of the cats' quick recovery from such things as high-rise syndrome. First mentioned by Dr. Gordon Robinson in 1976, high-rise syndrome was later studied by Whitney, W., and Mehlhaff, C., (1987) the Journal of the American Veterinary Medical Association. They documented 132 cases of cats plummeting many stories from high rise apartments, (*average* 5.5 stories) some suffering severe injuries. Interestingly, 90% of these cats survived. The record for survival from heights is 45 stories, however most cats suffer from falls of 7 stories or more and manage to live.

There has been some research which that suggests that domestic cats are in general less prone to postoperative complications following elective surgeries. Using computer records, Pollari and Bennet, (1996) state that complications following surgery for dogs undergoing castration to be averaged at 9.8%. The same surgery for cats lists the rate of complications to be 1.2%. Dogs undergoing overiohysterectomies (OHE) had complications 17.4% of the time and cats 8.4%. In another study by the same authors comparing paper records with computerized documentation, dogs undergoing castration complications varied from 2.4% to 22%, in cats 0.0% to 6.3%. With OHE complications varied from 6.5% to 17.7% in dogs and 3.6% to 16.% in cats. Lund et al. (1999) the records of 31,484 dogs and 15,226 cats at 52 veterinary practices to determine the most common disorders. Arthritis in dogs was listed as 2.4% of the population and was not listed as being reported in the cat. The prevalence of lameness in dogs occurred 3.1% of the time, in cats it is not mentioned as being reported. Healthy dogs were listed as 6.8% of the dog population, healthy cats 9.5%.

Bone and muscles/ligaments

Although it is impossible to standardize the healing time for dogs and cats in clinically occurring fractures, due to the type of fracture, amount of trauma to soft tissues, the type of treatment, the standard evaluation time or the after care, some general statements can be made, (Johnson, 2001). Cats do not have near the prevalence of orthopedic disease or ligament and muscle traumas as dogs do. Additionally, Toombs et al. (1985) suggests that non-union of fractures in cats is rare.

Osteo diseases that are rarely found in cats but can be found in all breeds and sexes of dogs include; Osteochondritis dissecans of the proximal humerous, scapulohumeral joint luxations, hip dysplasia. Osteo diseases in which cats are completely unaffected include fragmented coronoid process, ununited anconeal preoceese, traumatic elbow luxation, elbow subluxation, and legg-perenes. Osteosarcoma occurs much less frequently in the cat then in the dog. Johnson, 1999. Osteoarthritis and CPPd have only been found in large cats that were raised in zoological parks. The frequency of effected cats in the wild is apparently so low, that they are infrequently affected by these diseases in the wild. (Rothschild et al., 1998)

Myeloma is a tumor of plasma cells originating in the bone marrow. Only eight cats with multiple myeloma have been reported to have osteolytic bone lesions. 56% of all dogs reported with this condition involve bone. The metastatic behavioral differences between dogs and cats is that tumors in the dog involve the whole body, whereas in the cat it involves the distal ends of the extremities. In Lameness

With regard to the prevalence of ligament and muscle injuries and disease, those that are seen regularly in dogs but not in cats include, cranial crutiate ligament ruptures, meniscal injuries (torn ligaments), muscle contusions and strains, muscle contracture and fibrose, quadricepts contractor and inialsinatus, bicipital tenosynovitis, medial patellar luxation, lateral patellar luxation, osteochronditis dissecans of the stifle, and ligamentous injury of the tarsus. **Johnson**

One explanation for the lack of trauma or disease found in cat bone and muscle/ligaments is that cats are more sedentary then dogs, however this is a supposition and is not documented.

Respiratory

There have been studies that indicate that purring can aid in dyspnea as Cook in 1972 suggests. Kidd et al. in 2000 found in a study with 11 cats and 17 dogs with acute and subacute myocardial necrosis, none of the cats in the study had dyspnea, although all the dogs did. The overall incidence of primary lung tumors in the dog is 1.24%, and in the cat, .38% (Miles, 1988)

Tissue

Free skin grafting is often used for the treatment of large skin defects on the distal limbs of dogs and cats. However, while using this technique in dogs, the overlapped skin edges of the graft usually become necrotic by 3 days postoperatively, and need to be debrided. In cats, the grafts are usually viable even after six days.

Unfortunately, there has been no research that has attempted to *explain* the extraordinary ability cats have for healing themselves.

Just two years ago, Dr. Clinton Rubin and his associates made a fantastic discovery. They found that exposure to frequencies between 20-50 Hz (at low dB) creates the robust striations of increased bone density, Clinton Rubin, (1999), *Strain mediated augmentation of bone mass and morphology: Is it possible to harness the anabolic potential of mechanical stimuli without necessarily requiring exercise*, Wellcome Trust. In one study chickens were placed on a vibrating plate

every day for 20 minutes, and grew stronger bone, *National Geographic, January 2001*, p. 11. This discovery of anabolic frequencies between 20- 50 Hz (at low dB), is a tremendous breakthrough. Astronauts in space loose bone density in zero gravity, and this method could help them maintain healthy bones. Dr. Rubin's group has begun research trials with humans, designed to test whether this non-invasive method halts osteoporosis and perhaps even renews bone growth in post-metapausal women; J. Zhi, and M. Hadjrargyrou, (1999) *The expression of a novel and a known gene, unregulated by disuse is down regulated by anabolic mechanical stimulation*, American Society of Bone and Mineral Research. This method is not yet FDA approved, although it is hoped it will be soon. Additionally, Chen et.al (1994) *The effects of frequency of mechanical vibration on experimental fracture healing,* Zhonghua Wai Ke Za Zhi, in his work with rabbits, found that frequencies of 25 and 50 hertz promote bone strength by 20%, and stimulate both the healing of fractures, and the speed at which the fractures heal.

There is also documentation that low frequencies, at low dB are helpful with regard to pain relief, and the healing of tendons and muscles. Vibrational stimulation between 50-150 Hz has been found to relieve suffering in 82% of persons suffering from acute and chronic pain (*Lundeberg,* 1983). In 1999, M. Falempin and S.F. In-Albon discovered that mechanical vibration at 120 Hz counteracted atrophy in tendons after hind-limb muscle loading. Biomechanical stimulation which uses mechanical vibration of standardized frequencies from 18 - 35 Hz is used in Russian sports medicine. This technique improves the relaxation of strained muscle structures and increases the stretching ability of capsules and tendons. Lake in 1992, found that biomechanical stimulation prevents a decrease in muscle strength and muscle mass and the oxidative capacity of thigh muscles, following knee immobilization after sports injuries. The use of low frequency therapy also applies to tendon healing. It can increase the mobility of upper ankle joints by 16- 19 %, Klysczt et. al, 1997, *Biomechanical stimulation therapy as physical treatment of arthrogenic venous insufficiency*, Hautarzt. Exposure to frequencies between 2-100 Hz results in in the reduction of muscle spasms and more pronounced reduction of the spasms occurs the longer the treatment is applied, (D. Ardic, A. Buljina, 2000). After ten days of short periods of biomechanical stimulation, upper mobility of ankle joints improved by 16 and 19 degrees and was accompanied by the healing of venous ulcerations after skin flap transplantation, (Klysch, T. et al., 1997). It is interesting to note that Biomechanical stimulation is also used in public gyms and work-out centers to increase muscle mass. A web search will bring up many manufactures of such equipment.

It has also been found that in-phase chest wall vibration at 100 Hz, is known to decrease dysponea in patients with chronic obstructive pulmonary disease while at rest (Cristiano and Schwartzstein 1997; Nakayama, et al., 1998; Sibuya, 1994).

In Summary: Vibrations between 20-140 Hz are therapeutic for bone growth/fracture healing, pain relief/swelling reduction, wound healing, muscle growth and repair/tendon repair, mobility of joints and the relief of dyspnea.

We think that this research could help explain why cats purr, and here is why:

Fauna Communications has recorded many cats' purrs, at a non-profit facility and the Cincinnati Zoo, including the cheetah, puma, serval, ocelot and the domestic

house cat. After analysis of the data, we discovered that cat purrs create frequencies that fall directly in the range that is anabolic for bone growth.

· The dominant and fundamental frequency for three species of cats' purrs is exactly 25 Hz, or 50 Hz the best frequencies for bone growth and fracture healing. All of the cats purrs all fall well within the 20 - 50 Hz anabolic range, and extend up to 140 Hz.. All the cats, except the cheetah have a dominant or strong harmonic at 50 Hz.

· The harmonics of three cat species fall exactly on or within 2 points of 120 Hz which has been found to repair tendons. One species within 3 Hz and one within 7 Hz.

· Eighteen to thirty-five Hz is used in therapeutic biomechanical stimulation for joint mobility. Considering the small size of many of these cats, especially the domestic cats, it is interesting to note that that all of the individual cats, have dominant frequencies within this range. In fact, some of the cats, have 2-3 harmonics in this range.

· The frequencies for therapeutic pain relief are from 50-150 Hz. All of the individual cats have al least 5 sets of strong harmonics in this range.

· Therapeutic frequencies for the generation of muscle strength lie between 2-100 Hz. All of the individual cats have al least 4 sets of strong harmonics in this range.

· Therapy for COPD uses 100 Hz, all of the individual cats have a dominant frequency of exactly 100 Hz.

There is another clue found in a study performed by Dr. T. F. Cook, (1973) *The relief of dyspnoea in cats by purring*, New Zealand Veterinary Journal. A dying cat who could not breath (they were considering euthanasia), was found to breath normally once it began purring. The purring opened up the cat's airway, and improvement was "remarkable and the next day commenced to eat...." Three species of cats have a strong harmonic at exactly 100 Hz, the vibrational frequency found to relieve dyspnea. One species within 2 Hz and one species within 7 Hz of 100 Hz. It could be that the cat's purr decreases the breathlessness by vibratory stimulation.

Is it possible that evolution has provided the felines of this world with a natural healing mechanism for bones and other organs? Researchers at Fauna Communications believe so.

Being able to produce frequencies that have been proven to improve healing time, strength and mobility could explain the purr's natural selection. In the wild when food is plentiful, the felids are relatively sedentary. They will spend a large portion of the day and night lounging in trees or on the ground. Consistent exercise is one of the greatest contributors to bone, (Karlsson et al, 2001), and muscle (Roth et al, 2000; Tracy et al 1999), and tendon and ligament strength (Simoson et al, 1995; Tipton et al 1975). If a cats' exercise is sporadic it would be advantageous for them to stimulate bone growth while at rest. As well, following injury, immediate exercise can rebreak one and re-tear healing muscle and tendon (Montgomery, 1989). Inactivity decreases

the strength of muscles (Tipton et al, 1975). Therefore, having an internal vibrational therapeutic system to stimulate healing would be advantageous, and would also reduce edema and provide a measure of pain relief during the healing process.

One might question...What about other cats that don't purr??? **Stay tuned for the publication.**

Unfortunately, there is no easy way to test this hypothesis. Strangely, after speaking with several of the foremost specialists on animal bones, it was discovered that there has apparently never been a study on any small cat bones, not serval, caracal, puma, ocelot, or domestic. Only cheetah and tiger bones have been studied, and tigers do not purr. Cheetahs do purr, but they are one of the most unique and specialized forms of the felid family. The cheetah's bones were found to have dense remodeling (growth), which apparently is found in carnivores and in humans.

Purring-cat physiology would have to be compared to non-purring cat physiology to test this theory. The study would have to be entirely non-invasive.

There are inherent difficulties in discovering whether purring aids in healing, as purring-cat physiology would have to be compared to non-purring cat physiology. The dilemma is that most all cats purr, even under duress. They are even capable of producing a purr following a laryngectomy (Hardie et al, 1981), due to vibration of the diaphragm (Stogdale and Delack, 1985). A naturally occurring, non-purring cat is very rare, and this effect is usually associated with a physical problem. Cats that have physical problems related to purring cannot be admitted to the study because of the possible variables presented by the physical disability. Therefore, any research would have to be non-invasive and observation based.

Given the data on anabolic frequencies, fracture and healing research, the exact match of the frequencies and amplitudes of the cat's purrs to vibrational therapy research, time proven adages, biomechanical therapy, studies on tendon and muscle repair and Dr. Cook's study, it is certainly not a leap of faith to speculate that the cat's purr is a healing mechanism. Having a natural way to increase strength, and decrease healing time, would indeed be very advantageous and would explain the purr's development.

It is suggested that purring be stimulated as much as possible when cats are ill or under duress. If purring is a healing mechanism, it may just help them to recover faster, and perhaps could even save their life.

We are currently gathering veterinarian case studies and beginning a study to test the cats' purr-healing theory. No cats will, or have been harmed in this study. All of Fauna Communication's studies are non-invasive. We need your help for this research. We thank you for your support!

Please send your tax-deductible donations to:

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******Please note, before submitting your e-mail to our site we e-mail you and request your permission. We will not mention your name or e-mail address, unless you request it. Also before you e-mail us on this topic, we are *not* attempting to disprove the contentment theory, we are merely supplying an additional hypothesis as to what the purr may *do*. Additionally, this research is *not* designed to determine *how* the purr is created.**

For more information: E-MAIL or United States (919) 732-1322

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Cat's Purr Scientific Abstract

2pAB7. The felid purr: A healing mechanism?
Session: Tuesday Afternoon, Dec 04
Time: 3:15
Author: Elizabeth von Muggenthaler
Location: Fauna Commun. Res. Inst., P.O. Box 1126, Hillsborough, NC 27278, L@animalvoice.com
Abstract:
A current hypothesis suggests the purr indicates contentment, however, cats purr when they are severely injured or frightened. Forty-four felids were recorded including cheetahs, ocelots, pumas, domestic cats, and servals. A Sony TCD-D8 Digital Audio Recorder (DAT) and Statham Radio microphones recorded the purrs. FFTs and spectrographs were performed using National Instrument's Polynesia. An accelerometer was also used to measure domestic cat purrs. Every felid in the study generated strong frequencies between 25 and 150 Hz. Purr frequencies correspond to vibrational/electrical frequencies used in treatment for bone growth/fractures, pain, edema, muscle growth/strain, joint flexibility, dyspnea, and wounds. Domestic cats, servals, ocelots, and pumas produce fundamental, dominant, or strong frequencies at exactly 25 Hz and 50 Hz, the two low frequencies that best promote bone growth/fracture healing [Chen et al., Zhong.

Wai Ke Za Zhi. 32, 217--219 (1994)]. These four species have a strong harmonic exactly at, or within 2 Hz of 100 Hz, a frequency used therapeutically for pain, edema, wounds, and dyspnea. An internal healing mechanism would be advantageous, increasing recovery time and keeping muscles and bone strong when sedentary.

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1.) Domestic cat purr at 150 Hertz Fourier Transform

25 Hz 50 Hz 75 Hz 100 Hz

2. Domestic cat purr at 100 Hertz Spectrograph

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