# 'Four Seasons' in an animal rescue centre; classical music reduces environmental stress in kennelled dogs

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## HIGHLIGHTS

- Classical music increases HRV in kennelled dogs.
- Dogs display more relaxed behaviour when exposed to classical music.
- Dogs habituate to calming effects of music as soon as the second day of exposure.
- Male dogs have a more positive response to classical music than females.

## ARTICLE INFO

## ABSTRACT

On admission to rescue and rehoming centres dogs are faced with a variety of short- and long-term stressors including novelty, spatial/social restriction and increased noise levels. Animate and inanimate environmental enrichment techniques have been employed within the kennel environment in an attempt to minimise stress experienced by dogs. Previous studies have shown the potential physiological and psychological benefits of auditory stimulation, particularly classical music, within the kennel environment. This study determined the physiological/psychological changes that occur when kennelled dogs are exposed to long-term (7 days) auditory stimulation in the form of classical music through assessment of effects on heart rate variability (HRV), salivary cortisol and behaviour. The study utilised a cross over design in which two groups were exposed to two consecutive 7 day treatments; silence (control) and classical music (test). Group A was studied under silent conditions followed by 7 days of test conditions during which a fixed classical music playlist was played from 10:00–16:30 h. Group B received treatment in the reverse order. Results showed that auditory stimulation induced changes in HRV and behavioural data indicative of reduced stress levels in dogs in both groups (salivary cortisol data did not show any consistent patterns of change throughout the study). Specifically, there was a significant increase in HRV parameters such as μRR, STDRR, RMSSD, pNN50, RRTI, SD1 and SD2 and a significant decrease in μHR and LF/HF from the first day of silence (S1) to the first day of music (M1). Similarly, examination of behavioural data showed that dogs in both groups spent significantly more time sitting/lying and silent and less time standing and barking during auditory stimulation. General Regression Analysis (GRA) of the change in HRV parameters from S1 to M1 revealed that male dogs responded better to auditory stimulation relative to female. Interestingly, HRV and behavioural data collected on the seventh day of music (M2) was similar to that collected on S1 suggesting that the calming effects of music are lost within the 7 days of exposure. A small '9-Day' study was conducted in attempt to determine the time-scale in which dogs become habituated to classical music and examination of the results suggests that this occurs within as soon as the second day of exposure. The results of this study show the potential of auditory stimulation as a highly effective environmental enrichment technique for kennelled dogs. However, the results also indicate the requirement for further investigations into the way in which auditory stimulation should be incorporated within the daily kennel management regime in order to harness the full physiological and psychological benefits of music.

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## 1. Introduction

A recent study of pet ownership revealed that UK households were home to over 10.5 million pet dogs in 2006 [43]. Despite their position

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as one of the UK's most popular pets, welfare organisations cared for an estimated 129,743 dogs in 2009 alone [14]. The reasons for relinquishment included straying, inability of owners to care for them [18], abandonment and neglect [53]. The basis of animal welfare is contained within the concepts of the 'Five Freedoms' that is; freedom from hunger and thirst, discomfort, pain, injury and or disease, fear and distress and the freedom to express normal behaviour. Although rescue centres offer dogs a second chance through rehabilitation and rehoming, the kennel environment is inherently stressful and upon admission dogs are exposed to a variety of psychogenic stressors. For reasons often relating to practicality and expense the kennel is often spatially and socially restrictive (both intra and interspecifically), lacking in complexity, controllability and predictability [4,30,59]. In addition, isolation in a novel environment, separation from social attachment figures and regular exposure to high sound levels, all of which occur on kenneling, have been shown to elicit stress responses in dogs [51,62]. Continual exposure to such stressors results in chronic stress which is known to compromise welfare [5,6,19]. A number of studies have investigated whether there are simple, economical methods of addressing potential shortfalls in kennel design and management to minimise the stress experienced by kenneled dogs. These studies have employed a variety of forms of environmental enrichment defined as any animal husbandry principle which seeks to enhance the quality of captive care by identification and provision of environmental stimuli necessary for optimal physiological and psychological well-being [54]. Several studies have reported welfare benefits of animate (social) enrichment as a result of socialisation with conspecifics [32,41] and humans [7,16]. In addition, inanimate enrichment, that is alteration of the physical environment, can also be an effective means of alleviating kennel induced stress for example the provision of toys [52], the addition of furniture [35] and visual [26], olfactory [25] and auditory [38,68] stimulation.

The physiological [44,60] and psychological [2,57] benefits of listening to music are well documented in but not solely attributed to humans. Music has been reported to increase milk yield [2] and use of automatic milking machines in dairy cows [64], result in reduced stereotypic behaviours in captive Asian elephants [71] and have beneficial effects with regard to stress related behaviours in zoo-housed gorillas [70]. The potential use of music as an auditory environmental enrichment technique for dogs in the kennel environment has also been reported [38,68]. However, in these studies the duration of auditory stimulation and/or the trial were limited. Both studies reported changes in the activity of dogs when exposed to music; specifically, classical music increased the amount of time spent sleeping and reduced barking, while heavy metal music increased barking and body shaking. Given the intermittent nature and limited duration of exposure to music (45 min to 4 h) in these studies it is difficult to ascertain whether the observed effects of auditory stimulation, would be effective to reduce stress experienced by dogs in a working kennel environment in the long term.

In dogs, the response to stressors is multifactorial and results in both behavioural [6,9,38] and physiological changes [9,16,30]. Key elements of the mammalian stress response are the coordinated activation of the sympathetic nervous system and the hypothalamo-pituitary adrenal (HPA) axis, which drive adaptive psychological and behavioural changes. A variety of methods are available to monitor stress including quantification of circulating hormones as a measure of the physiological response and behavioural observations which provide a measure of the integrated response of an animal to its environment. The adrenal hormone cortisol is one of the main hormonal mediators of the effects of stress in mammals [29] and can be measured in several biological samples including plasma, saliva, urine and faeces. Plasma cortisol concentrations have been shown to correlate well with stress, however due to its pulsatile release and its sensitivity to acute events, including restraint and venepuncture, concentrations can be unreliable/variable. Salivary cortisol concentrations have the advantages that sample collection is relatively non-invasive [37] and that it represents cortisol

secretion over a longer time period of minutes to hours rather than the single time point measurement obtained from a plasma sample. The collection technique and associated handling required to retrieve a saliva sample although usually well tolerated, can elicit a stress response. However, basal cortisol concentrations can be measured if saliva samples are collected in less than 4 min [37]. Salivary cortisol concentrations have been shown to be related to stress levels in a number of animals including sheep [23], pigs [15], cattle [47] and dogs [29,46]. The utility of cortisol concentrations as a simple measure of the activity of the HPA axis, however, is compromised by the fact that chronic stress can result in dysregulation including changes in receptor number and sensitivity [72] and changes in adrenal sensitivity [31]. In addition to activation of the HPA axis stress can also result in changes in activity within the autonomic nervous system. As the activity of the autonomic nervous system has dramatic effects on cardiac function, an alternate non-invasive means to monitor aspects of the physiological response to stress is analysis of effects on heart rate variability (HRV) [58]. Specifically, HRV is the difference in beat-to-beat intervals (R–R interval) which is derived from the non-additive input to the heart of the two branches of the autonomic nervous system. HRV analysis is based on the fundamental principle that healthy cardiac function is characterised by irregular time intervals between consecutive heart beats. Work in humans has shown that higher resting HRV is associated with the enhanced control of emotions, thoughts and behaviour [10]. HRV is also relatively easy to measure in a variety of farm animals [65], cats [1] and dogs [7]. Variation in HRV parameters has been associated with a series of factors in different species, such as genotype, behaviour, environment, temperament, performance and nutritional status in the horse [65,66] emotional state in sheep [49] and production systems in cattle [27,28]. A previous study in dogs has demonstrated that the reduction in stress, observed in response to increase human interaction, is also associated with changes in HRV parameters [7].

This study tested the hypothesis that playing classical music to dogs housed in an animal rescue and rehoming centre would reduce physiological and psychological stress. Specifically the study investigated the effects of daily exposure to classical music, for 7 days, on the HRV, salivary cortisol and behaviour of dogs living in a working rescue kennel environment and assessed whether the response to stress was influenced by factors such as sex, age, breed, gonadal status, body condition score (BCS), reason for kennelling and duration of stay.

## 2. Materials & methods

### 2.1. Subjects

This study was conducted at the Scottish SPCA Dunbartonshire and West of Scotland animal rescue and rehoming centre (ARRC) from July 2013–March 2014. This study coincided with normal husbandry and operational procedures within the centre which included visits by the general public and rehoming of animals. As the Scottish SPCA rescues and rehomes injured, neglected, abandoned or unwanted animals, dogs included in this study were from a variety of different backgrounds and varied in breed and age. In an attempt to ensure researcher safety any dogs which had displayed aggressive behaviour were not included in the study.

The subjects included in this study consisted of 50 dogs; 25 neutered (Nx) and 9 entire (E) males (n = 34) and 12 Nx and 4 E females (n = 16). The reason for being at the ARRC was n = 20 admitted as strays (S), n = 22 unwanted pets (U), n = 6 held for temporary refuge (TR) and n = 2 sequestered due to welfare issues (W). Dogs were categorised into 7 age groups (age estimated from dentition for stray dogs (n = 20)); <0.5 years (n = 6), 0.5–1.9 years (n = 8), 2–3 years (n = 17), 3.1–5 years (n = 7), 5.1–8 years (n = 10), 8.1–9.9 years (n = 1) and >10 years (n = 1). Duration of stay prior to the study was calculated as the difference between the date of arrival and the first day of data collection. This ranged from 1 to 231 days with a