UNIVERSITI PUTRA MALAYSIA

EFFECT OF AUDITORY ENRICHMENT ON THE STEREOTYPIC BEHAVIOURS IN CAPTIVE TIGERS (Panthera tigris)

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EFFECT OF AUDITORY ENRICHMENT ON THE STEREOTYPIC BEHAVIOURS IN CAPTIVE TIGERS *(Panthera tigris)*

LIEW JO YEE

A project paper submitted to the
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CERTIFICATION

It is hereby certified that we have read this project paper entitled "Effect of Auditory Enrichment on the Stereotypic Behaviours in Captive Tigers (*Panthera tigris*)", by Liew Jo Yee, and in our opinion, it is satisfactory in terms of scope, quality, and presentation as partial fulfilment of the requirement for the course VPD 4999 – Final Year Project.

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DEDICATION

This thesis is dedicated to my:

Beloved family

Main supervisor

Dr Azlan Che' Amat

Co-supervisors

Assoc. Prof. Dr Hafandi Ahmad

Dr Michelle Fong Wai Cheng

Dr Zubaidah Kamarudin

My best friend

Shashini Nair

My seniors

Dr Tan Zi Yan

Dr Nimallan

My batchmates of DVM24

Tigers in NWRC

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mosquitoes at the centre. It was a pleasure having this great group of people working with me.

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ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999: Projek Akhir Tahun.

KESAN PENGGALAKKAN AUDITORI TERHADAP TINGKAH LAKU STEREOTAIP HARIMAU (*Panthera tigris*) DI DALAM KURUNGAN

Oleh

LIEW JO YEE

2024

Penyelia Utama: Dr Azlan Che' Amat

Penyelia Bersama: Profesor Madya Dr Hafandi Ahmad, Dr Michelle Fong Wai Cheng dan Dr Zubaidah Kamarudin

Rangsangan auditori telah digunakan sebagai satu bentuk penggalakkan bagi mengurangkan tingkah laku stereotaip haiwan dalam kurungan. Harimau (*Panthera tigris*) terkenal dengan tingkah laku stereotaip mereka, walau bagaimanapun terdapat pengetahuan terhad tentang penggalakkan pendengaran bagi spesies ini. Muzik klasik didapati mempengaruhi tingkah laku dan fisiologi haiwan kurungan dalam pelbagai kajian, menunjukkan bahawa muzik klasik mungkin menyumbang kepada peningkatan kesejahteraan haiwan. Matlamat kajian ini adalah untuk menerangkan kesan

penggalakkan auditori menggunakan muzik klasik terhadap tingkah laku stereotaip harimau kurungan. Haiwan (betina; n=2, jantan; n=2) di National Wildlife Rescue Centre telah didedahkan dalam dua keadaan untuk kajian tingkah laku; 1) Tiada rangsangan auditori (Kawalan) dan 2) Rangsangan auditori (Muzik klasik). Tingkah laku setiap harimau direkodkan dua kali sehari pada waktu petang dan malam dengan selang 10 minit dalam setiap keadaan selama 5 hari menggunakan teknik persampelan segera. Etogram telah disediakan dengan senarai tingkah laku yang terdiri daripada tiga kategori utama: aktif, berehat dan stereotaip. Pembesar suara 'bluetooth' digunakan sebagai peranti pendengaran semasa rangsangan audio, dan julat desibel tetap antara 60-70 dB. Sepanjang tempoh pemerhatian, gabungan trek yang memainkan pelbagai muzik klasik daripada senarai lagu yang dipilih memulihkan keadaan percubaan. Tiada kesan statistik yang signifikan terhadap rangsangan pendengaran dengan tingkah laku stereotaip harimau tetapi keputusannya menunjukkan corak penurunan dalam tingkah laku stereotaip daripada tempoh kawalan kepada rangsangan bunyi. Walau bagaimanapun, rangsangan pendengaran mempunyai kecenderungan penurunan ke atas tingkah laku rehat harimau. Ini mungkin menunjukkan bahawa rangsangan pendengaran dengan muzik klasik terpilih mungkin berguna dalam mengurangkan tekanan tingkah laku harimau dalam kurungan. Secara keseluruhannya, penemuan ini mencadangkan bahawa kesan muzik klasik terhadap tingkah laku haiwan adalah kompleks dan jangka masa penilaian yang lebih panjang diperlukan bagi memperoleh kesimpulan yang muktamad.

Kata kunci: auditori, penggalakkan, muzik klasik, tingkah laku stereotaip, harimau tawanan.

ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfilment of the course VPD 4999: Final Year Project.

EFFECT OF AUDITORY ENRICHMENT ON THE STEREOTYPIC BEHAVIOUR OF CAPTIVE TIGERS (*Panthera tigris*)

By

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2024

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Auditory stimulation has been utilized as a form of enrichment to reduce stereotypic behaviour in captive animals. Tigers (*Panthera tigris*) are well-known for their stereotypic pacing, however there is limited knowledge about auditory enrichment for this species. Classical music appears to influence the behaviour and physiology of captive animals in a variety of studies, suggesting that it may contribute to the improved well-being of the animals. The aim of this study was to describe the effect of auditory enrichment using classical music on the stereotypic behaviour of captive tigers. Animals (females; n=2, males; n=2) at the National Wildlife Rescue Centre were exposed to two

conditions for the behavioural study; 1) No auditory stimulation (control) and 2) Auditory stimulation (classical music). The behaviours of each tiger were recorded twice daily in the afternoon and at night with a 10-minute interval in each condition for 5 days using an instantaneous sampling technique. An ethogram was prepared with a list of behaviours that comprise three main categories: active, resting and stereotypic. A 'bluetooth' speaker was employed as the auditory device during the audio stimulation, and it was tuned to a constant decibel range between 60-70 dB. Throughout the observation period, a mix of tracks that plays a variety of classical music from the selected playlist heals the experimental condition. There was no statistically significant effect of auditory stimulation on the stereotypic behaviours of the tigers but the results revealed a decrease pattern in stereotypic behaviours from the control period to sounds stimulation. However, auditory stimulation had a significant effect of decreasing trend on the resting behaviours of the tigers. This could indicate that auditory stimulation with selected classical music may be useful in reducing behavioural stress of the captive tigers. Overall, these findings suggest that the effects of classical music on animal behaviour are complex and a longer term of evaluation is needed before definitive conclusions can be drawn.

Keywords: auditory, enrichment, classical music, stereotypic behaviours, captive tigers

1.0 INTRODUCTION

Every living thing on earth has been named and classified. These biological classifications known as taxonomy show how different living things are related to each other. The tiger is a mammal placed within the Carnivora order. It is classified under the Felidae family and categorised as the Panther genus. To date, the number of tigers in the wild has been diminishing noticeably. They are classified as one of the endangered and threatened species under the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. There are nine main subspecies of the *Panthera tigris* but currently, three of them have already been declared extinct. Therefore, zoos and conservation centres play a major role in combating this issue. However, captive animals are prone to have difficulty in expressing its natural behaviour in an unfamiliar environment. Stereotypic behaviour being exhibited is one type of coping mechanism for the animal (Mason, 1993). This behaviour is sought to be repetitive, unchanging, and seemingly functionless because of the lack of stimulation (Mason, 1991). The incidence of stereotypic behaviours is concerning as it reflects on the welfare of the captive animals that could be associated with stress, boredom or aggression. There is a consensus that the limitations of a captive environment can lead to the performance of stereotypic behaviour in many species (Szokalski et al 2012). In combining data from various observational studies, Clubb and Mason (2007) reported that captive adult tigers spend 16% (median) of behaviour scans engaged in stereotypic pacing.

Several studies on sensory stimulation have been done to study their potential method of environmental enrichment for captive animals (Wells, 2009). Among the types of sensory stimulation are auditory, olfactory, visual, tactile and taste. There are limited studies done on the effect of auditory enrichment on the behaviours of tigers. Often classical music has been reported to have a calming effect in human. Based on Ramdinmawii and Mittal (2017), classical music indeed helps in achieving relaxed or meditative state of the human mind. Classical music appears have an effect to the behaviour and/or physiology of animals in a way that indicates improved well-being. Nonetheless, there are only minimal studies done using classical music as auditory enrichment to captive tigers.

1.1 Objective

To describe the effect of auditory enrichment on stereotypic behaviours of captive Malayan tiger.

1.2 Hypothesis

Null hypothesis (H0): The stereotypic behaviours of captive tigers are not significantly affected by auditory enrichment.

Alternative hypothesis (H1): The stereotypic behaviour of captive tigers is significantly affected by auditory enrichment.

1.3 Justification

This study will provide us insight on the stereotypic behaviour in captive tigers and the use of classical music as auditory enrichment on stereotypic behaviour in them.

2.0 LITERATURE REVIEW

2.1 Tigers

Panthera tigris, 1758 (formerly *Felis tigris linnaeus*) is the largest species of the Felidae family in the Order Carnivore, and is solely found on Asian continents (Department of Wildlife and National Parks, 2008; Goodrich et al., 2015). According to Kitchener and Yamaguchi (2005), it is distinguished by vertical black and white stripes on orange fur. As of today, various subspecies of tigers are classified as endangered or critically endangered, emphasizing the urgency of conservation actions to secure their future. The history of *P. tigris* is marked by a resilient species facing immense challenges in a rapidly changing world, with ongoing efforts focused on preserving their existence for future generations (World Wide Fund for Nature, 2021). Tigers are primarily solitary creatures, with adults typically living alone except during mating or when a mother is raising her cubs. They are territorial, marking their territories through scent marking and vocalizations, establishing and defending areas essential for hunting and breeding. A tiger's territory can be vast, ranging from 10 to 30 square kilometres or more, depending on the availability of resources (National Geographic, 2021).

2.2 Main senses of tigers

Tigers have highly developed senses that help them survive by allowing them to navigate their environment, hunt effectively, and communicate. Tigers' main sense are sight, hearing, smell, and touch which all contribute to their apex predator prowess and ability to survive in their native surroundings. (Smithsonian's National Zoo & Conservation Biology Institute, n.d.).

2.2.1 Sense of sight

Tigers have exceptional vision, with sharp eyesight that aids in detecting movement and judging distances. Their night vision is exceptionally good, giving them an edge in low-light situations and allowing them to be successful nocturnal hunters. The pupils of the tigers are rounded and dilated to capture more light at night for its rod dominant retina (Ullas Karanth, 2003).

2.2.2 Sense of hearing

Tigers have excellent hearing, and their ears are adapted to perceive a wide variety of frequencies, even sounds that people may find inaudible. Their keen hearing enables them to identify prey and communicate over great distances via vocalisations, which aids in social relationships and hunting (Smithsonian's National Zoo & Conservation Biology Institute, n.d.).

2.2.3 Sense of smell

Tigers possess a highly developed sense of smell. Their olfactory abilities help them detect scents, track prey, and identify other tigers in their territory. Smell is crucial for communication and locating potential prey or mates. It allows them to assess the environment, detect potential threats, and find suitable prey animals. The highly sensitive olfactory system of tigers contributes significantly to their survival, social behaviors, and hunting strategies in the wild, showcasing the importance of this sense in their everyday lives. (Smithsonian's National Zoo & Conservation Biology Institute, n.d.).

2.2.4 Sense of touch

While less prominent than their other senses, tigers' sense of touch plays a role in their social interactions, grooming, and exploring their surroundings. The functions of whiskers, paw pads, and other tactile receptors play a crucial role in stalking, attacking, and manipulating prey (Ullas Karanth, 2003).

2.2.5 Sense of taste

Tigers, as carnivores, have taste receptors that let them detect appealing food sources and distinguish between different types of meat. While their taste perception for different flavours may be less developed than that of omnivores or herbivores, they are thought to have taste buds sensitive to detecting sour, bitter,

sweet, and possibly salty flavours, guiding their food preferences and assisting in the selection of appropriate prey items (Zhang et al., 2015).

2.3 Ethogram study

Ethograms can be as simple as a list of behaviours by name, or as elaborate as line drawings of behavioural parts or sequences, or as graphical representations of interactive sequences (McDonnell and Poulin 2002). Ethogram design is critical in the study of animal behaviour because it defines the scope of analysis and often dictates the direction of future research. Animal behaviours are subject to interpretation in the absence of such ethograms, and studies of behavioural ecology may become unclear. Each species' activity patterns developed to optimise the time of behaviours required for survival and reproduction (Schmidt et al. 2009).

2.4 Feeding behaviour

Natural behaviours such as hunting may be difficult to show in captive tigers due to spatial constraints. (Vaz et al., 2017) Furthermore, the lack of a live prey basis and the provision of pre-prepared foods prevents them from engaging in natural hunting activities and energy expenditure. (Szokalski et al., 2012) It is not alarming knowing that tigers do poorly in captivity because adult tigers in the wild often live alone and have wide home ranges (Sunquist, 2010). They spend the majority of the day either sleeping or patrolling their territory (Zhen-sheng et al., 2002), and hunt at night (though some hunting can occur

during the day) (Sunquist, 2010). The habitat for tigers in captivity, on the other hand, is dramatically different. They are frequently housed alongside or near other tigers (as well as other species), and physical and financial constraints limit cage size, resulting in substantially narrower 'territories'. (Szokalski et al., 2012).

2.5 Reproductive behaviour

According to a Seal et al. (1987) study on behavioural profile, behaviour is reported as an almost quantitative indicator of estrus in females. Examples of these behaviours are vocalization, prustening, rubbing against the walls and bars of enclosure, social roll, and lordosis/semi-lordosis. According to Tommasi et al. (2021), males exhibit higher Flehmen's reaction than females. This is a close-range investigative behaviour towards volatile compounds known as pheromones (Senger, 2012).

2.6 Stereotypic behaviour

Pacing is the most common kind of stereotype developed by big cats in zoos (Clubb and Mason, 2007). Restricted movement due to space limitations was considered one of the primary contributors to captivity-induced stress, and previous studies on abnormal behaviour of captive animals also supported this observation. When researchers quantified the influence of enclosure size on distance covered and paced (stereotyped) by tigers in 14 enclosures ranging in size from 21 to 35865 m^2, they discovered that in eight of them with less than 1000 m^2 area, enclosure size was negatively linked to pacing. (Vaz et al., 2017).

2.7 Auditory enrichment

Enrichment is potentially one of the caretaker's most powerful tools to improve welfare for an individual. Enrichment is covered in virtually all husbandry plans issued by regional and national associations, so managers and keepers are aware of the options. According to Lutz and Novak (2005), music appears to be more promising than naturalistic noises as a type of auditory enrichment. Music exposure can modulate amygdala and nucleus accumbens activities since the amygdala plays a significant role in responding to stressful situations and also modulates stress responses (Andolina and Borreca, 2017).

2.8 Classical music

Classical music also appears to have an effect on the behaviour and/or physiology of captive animals in a manner suggestive of enhanced well-being (Wells et al., 2009). Thus, Gvaryahu et al. (1989) showed a rise in the growth rate of hens exposed to classical music, while the potential confounding impact of other environmental variables present in this study has been expressed (Newberry, 1995). Mozart's music (sol major, K525) has recently been demonstrated to improve carcass and fatty acid composition in common carp (Papoutsoglou et al., 2007). Behavioural assessments add to the evidence for classical music's potentially beneficial effect on animal wellbeing.

2.9 Auditory studies in tigers

Hearing is the cat's second most essential sense, and with thirsty muscles operating each external ear as opposed to six in man, it can turn its ears accurately to seek sound. A cat's ear-turning is far faster than a dog's. (Taylor, 1989). Furthermore, the stimulus frequency otoacoustic emissions data by Bergevin et al. (2012), indicate that tigers have a larger tonotopic mapping constant (mm/octave) than domestic cats. A larger mapping constant in tiger is consistent both with auditory brainstem response thresholds (that suggest a lower upper frequency limit of hearing for the tiger than domestic cat) and with measurements of basilar-membrane length (about 1.5 times longer in the tiger than domestic cat). It should be considered whether big cats are auditory generalists in terms of acoustic sensitivity, but have a peripheral specialisation impacting low-frequency neuronal latencies (Walsh et al., 2011). Preliminary research indicates that *Panthera tigris* subspecies may rely on low-frequency audio cues while conversing with conspecifics in the wild or in captivity. This perspective is supported since individuals are sensitive to tone bursts in the 300-500Hz range, while close encounter roars release tremendous acoustic energy in an overlapping frequency region. (Walsh et al., 2004).

3.0 METHODOLOGY

3.1 Ethical statement

The research protocol in this study was approved by the Institutional Animal Care and Use Committee of Universiti Putra Malaysia with the reference number (UPM/IACUC/AUP-U036/2023) and PERHILITAN research permit.

3.2 Study site and animals

The study was conducted at the National Wildlife Rescue Centre (NWRC), Sungkai, Perak for 10 days. These captive tigers were based on availability and permission obtained from the centre and PERHILITAN (research permit). Thus, four tigers were selected from convenience sampling.

Table 1: The characteristics of the selected tigers

Name	**Species**	**Sex**	**Origin**	**Age (years)**
Sungkai	*Panthera tigris jacksoni*	Male	Captive since birth. Born in NWRC.	9
Jay	Hybrid	Male	Captive bred since around 1 year old. Acquired from Zoo Johor	9
Stacy	*Panthera tigris corbetti*	Female	Captive since 6 months old Rescued from Hulu Langat	7
Zanah	*Panthera tigris jacksoni*	Female	Captive since young. Acquired from Langkawi wildlife park	15

The selected tigers were kept in different cages as individuals. All subjects were housed in different blocks of the centres except for Jay and Stacy. The tigers were housed adjacent to another tiger of the opposite sex to induce mating behaviour as part of the breeding programme in the centre. All of the cages of each block are connected to one common play area known as the exercise yard which comprises an artificial pond, trees, and scrubs. The tigers in each block were moved among two enclosures or released into

the exercise yard for husbandry management daily. The cleaning is usually done in the morning around 9.00 am. The enclosure was equipped with enrichment such as tree barks and wooden furniture. The tigers are let out into the exercise yard on alternative days. They were fed 6 days a week with different types of meat such as chicken and beef and a moat with sufficient clean water was provided. Feeding time is usually done around 4.00 pm daily and they are fasted once a week.

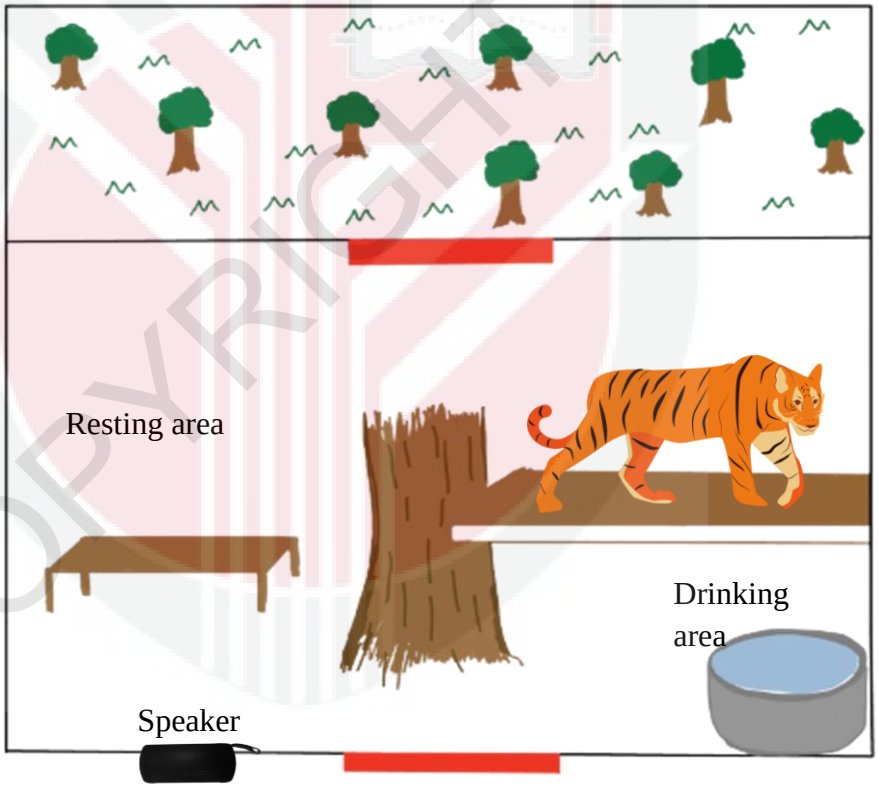

Figure 1: The layout of the tigers' enclosure in NWRC

3.3 Ethogram

Ethogram for captive tigers was prepared prior to the observation period and they were categorized into three main categories based on Mohapatra et al. (2014); Kusamarani et al. (2019); Vaz et al. (2017).

Table 2: Ethogram of captive tigers' active behaviours

Active behaviours	Description
Alert	Standing or lying, open eyes focused on object, conspecies or human
Aggression	Growling, snarling, swatting, or attacking another tiger or threat
Clawing	Sharpening nails of paw in trees or wooden log
Drinking	Drinking water from pool or moat
Feeding	Consuming prey, tearing meat, and chewing bones.
Scent marking	Spraying urine, and leaving scent marks
Smelling	Moving head toward object and sniffing the same
Stalking	Slow walking movement, with all legs slightly bent and eyes focused on specific item
Walking	Ambulatory movement in a specific direction with an apparent goal; a symmetrical gait in which each foot is on the ground more than half the time
Vocalizations	Roaring, growling, purring, moaning, and chuffing

Table 3: Ethogram of captive tigers' resting behaviours

Resting behaviours	Description
Grooming	Licking or cleaning its fur and body
Laying on back	Resting on the back usually followed by roll over
Resting awake	A general inclusive term for lying in a relaxed manner with eye open or partially open
Roll over	Animal rotates its body on the longitudinal axis coming to rest on the dorsal surface
Sitting	Stationary position with straight foreleg and folded hind leg
Sleeping	Immobile; resting with eyes closed
Yawning	A wide gap with deep inhalation. The eyes may be slitted or closed and tongue protruded out.

Table 4: Ethogram of captive tigers' stereotypic behaviours

Stereotypic behaviours	Description
Pacing	Moving back and forth around the same area. Repeated walking movement in the same path, without an apparent goal
Walking in circles	Repeated walking or running in a circular pattern.
Over-grooming	Grooming to an excessive extent, pulling out hair or feathers, often leaving bald patches, irritated and broken skin

3.4 Experimental design

Two conditions of auditory stimulation were developed for the study.

3.4.1 Control

In this condition, the tigers were not exposed to any auditory stimulation other than that arising naturally from the animals' environment.

3.4.2 Enrichment

Under this condition, the animals were exposed to a randomly chosen mixture of tracks that plays a variety of classical music from the playlist 'The Classic experience – 135 of the greatest classical tracks' throughout the observation period.

3.4.3 Procedure

Each of the two conditions was 5 hours a day for 5 days. The tigers were first studied in the control condition then the classical music condition. Observations were done on the animals through direct observation by assigned observers using the instantaneous focal sampling method. Each slot represents an occurrence of a specific behaviour at 10-minute intervals regardless of frequency are recorded. 1200 to 1600 and 2100 to 2200 for each of the condition. The auditory device used was a 'Bluetooth' speaker that will be placed in an area inaccessible to the tigers. The music is set at a range of 60 to 70 dB which is not inappropriately loud to the

human ear. The decibel of the music is monitored using a decibel sound level meter application. It is confirmed that the sounds could be heard throughout the enclosure before the experimental condition is being carried out.

3.6 Data analysis

The total number of times each tiger observed performing each type behaviour are summed for each condition was summed up, providing an overall frequency count per tiger per behaviour. A paired t-test was used for the type of behaviours to determine whether the animals' behaviour was influenced by the auditory stimulation.

4.0 RESULTS

Table 5: Tigers' behaviours per condition of auditory stimulation

Behaviours	Control mean (S.E.)	Enrichment (S.E.)	*P*
Active	128.75 (14.41)	105.50 (26.48)	0.495
Resting	177.25 (8.46)	150.00 (11.68)	0.037
Stereotypic	62.25 (7.43)	45.25 (7.25)	0.310

The mean ± S.E. number of times tigers were recorded exhibiting each behaviour during the two condition of the auditory stimulation. P-values arising from paired t-test are presented.

Based on Table 5, it is revealed that there was no statistically significant effect of auditory stimulation on the tigers' active and stereotypic behaviours ($p > 0.05$). However,

there was a statistically significant decrease in the resting behaviours of the tigers ($p<0.05$) where $p=0.310$.

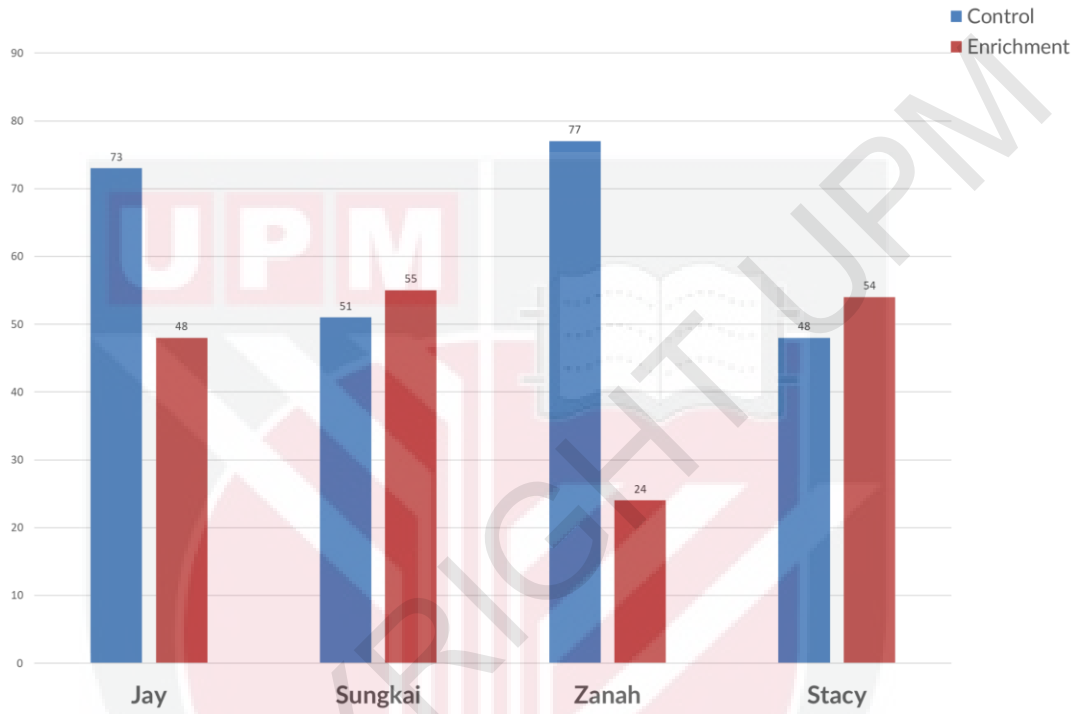

Figure 2: Frequency of stereotypic behaviours

Figure 2 depicts the frequency of stereotypic behaviours of each tiger during the control period and the enrichment period. Jay and Zanah shows a significant decline in stereotypic behaviours while Sungkai and Stacy shows a slight increase.

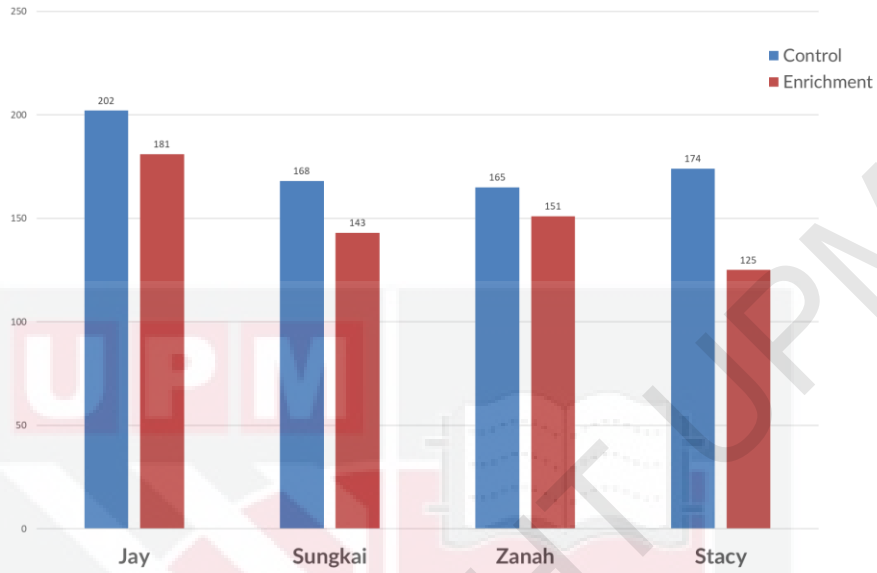

Figure 3: Frequency of resting behaviours

Figure 3 illustrates the frequency of resting behaviours by each tiger. It is observed that all the tigers indicate a decrease in resting behaviours.

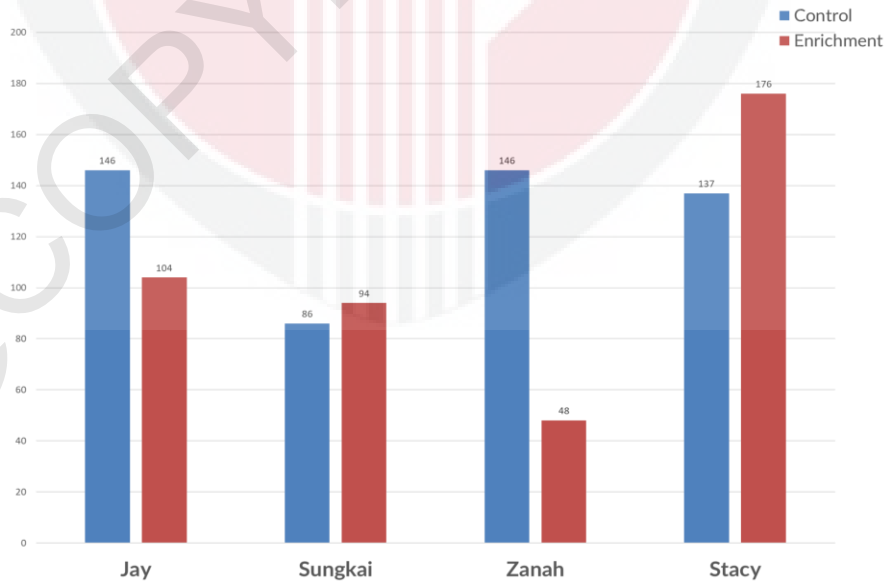

Figure 4: Frequency of active behaviours

Figure 4 demonstrates the frequency of active behaviours for each tiger. Two tigers, Jay and Zanah displayed a decrease in active behaviours while the other two tigers, Sungkai and Stacy shown a increase in active behaviours.

5.0 DISCUSSION

There was no statistically significant effect of auditory stimulation on the tigers' active and stereotypic behaviours ($p > 0.05$). This may be because there were tigers that showed increase and also a decrease in both active and stereotypic behaviours. However, there was a statistically significant decrease in the resting behaviours of the tigers ($p<0.05$). This is likely because all of the tigers revealed to have a decline in their resting behaviours.

Nonetheless, there was a pronounced decrease trend of stereotypic behaviours that can be observed in two of the tigers, Jay and Zanah. This decrease in trend was also reported in a study by Wells et al, (2006) where the captive gorillas exposed to classical music exhibited lesser behaviours that are typically associated with stress. Wells and Irwin (2008) reported that their study revealed the elephants present significantly less time stereotyping during the experimental condition (exposure to classical music) than the control. However, two other tigers, Sungkai and Zanah showed a slight increase in stereotypic behaviours. This contradicts their studies but it may be due to external factors. For instance, all of these tigers were housed adjacent to other tigers and it has been

reported that tigers housed adjacent to other tigers tend to display more pacing (Bashaw et al., 2007; De Rouck et al.,2005)

All tigers had shown a decrease in resting behaviours from the auditory stimulation. In most studies done on classical music, it has been reported that animals exhibit an increase in resting behaviours. Dogs exposed to classical music have been recorded to show more resting behaviours and a decrease in vocalisation (Kogan et al., 2012; Wells et al., 2002). Lambs were observed to be in a calmer state (Arehart & Ames, 1972). However, in this case, the tigers showed a decline in their resting behaviours. This could be because the female tigers may be in estrus and they usually show more signs of restlessness. (Palita et al., 1996) The estrual cycle of the female tigers influences the libido stimulation of the male tigers, thus, they tend to show signs of vocalisation and Flehmen's response. Hence, this may be the reason for their restlessness (Putranto et al., 2007).

In terms of active behaviours, two of the tigers, Sungkai and Stacy exhibited an increase in their active behaviours. It could be a possibility of the classical music being a mask for extraneous effect or enrichment effect. Short-term classical music stimulation has been reported to have increase the active behaviour in fattening pigs. (Gao et al., 2023) Classical music was deduced to increase active behaviours in bottlenose dolphins. (Guérineau et al., 2022). On the other hand, the other two tigers, Jay and Zanah showed a decrease in active behaviours. The relaxing qualities of classical music may have helped to create a peaceful environment and promote calmer behaviour. According to Ediriwarne in 2022, classical music seems to alleviate aggression in his study.

Some assumptions may be drawn explaining the difference in individual responses for the tigers. On fasting days, some tigers appear to have more active behaviours compared to feeding days. A similar observation was noted in a study reported in lions. (Höttges, 2019). Environmental interferences may also play a role as previously mentioned, Tigers housed adjacent to other tigers usually exhibit more behaviours of pacing (Bashaw et al.,2007; De Rouck et al., 2005). Individual preferences may be a factor causing different individual responses. A similar study done in chimpanzees by Wallace et al. (2017) showed that specific individuals preferred certain music over others. Observer bias should also be considered since each tiger was assigned to a different observer. This is because observer bias may influence the subjective scores of animal behaviour and welfare. (Tuyttens, 2012).

The expectation that animals will respond positively to classical music as auditory enrichment is not universally valid. Auditory enrichment may prove to be a successful type of enrichment that is simple to implement and vary, but it is important to evaluate people's responses to this enrichment. While conducting enrichment-based studies in conservation centres and zoos presents challenges due to a lack of control over all environmental factors and staff time constraints, this study serves as a preliminary effort to systematically evaluate the impact of auditory enrichment in captive tigers.

6.0 CONCLUSION

Unlike some previous works in other animals, tigers showed a statistically significant decrease in resting behaviours in the presence of classical music. On the other hand, a decrease trend in the mean frequency of active and stereotypic behaviours can be seen for this study. However, although this was a case study on a small sample size (n= four tigers), auditory enrichment could be an effective stimulus for captive animals. Still, care must be taken to monitor specific reactions to different types of stimuli. Other factors should be taken into consideration as well before drawing a definite conclusion.

7.0 LIMITATIONS OF THE STUDY

Among the limitations of this study is interference from the observers during the observation period. The presence of the observers may affect the behaviours of the tigers as they were not camouflaged and visually seen by the tigers. Observer bias is considered one of the limitations as well. This behavioural study involves observations by study participants; thus, observer bias can occur if the observer's expectations or preconceived notions influence the way behaviours are interpreted or recorded. Moreover, another limitation would be the synchronicity of the music being played as different tracks of the playlist may have been played at different times to each tiger since the tigers were at different locations. Besides, another limitation would be the range the auditory speaker could reach.

8.0 RECOMMENDATIONS

For further studies, it is recommended to use cameras to observe the behaviours of the tigers. The cameras can observe blind spots that are unable to be observed by the observers as well as reduce interference to the tigers from the presence of the observers. Prior to the research being conducted, the observers should be evaluated first ensuring the subjective scoring for the ethogram is uniform. Besides, a longer duration of study is highly suggested to ensure that the tigers adapt to the classical music as it may be considered foreign. Therefore, a longer duration may remove the uncertainty of whether classical music accurately serves its purpose in influencing their behaviours. Another recommendation is to have more individual variability so that a generalised hypothesis can be concluded to assess the application of this study to all tigers. Furthermore, it is recommended to use at least two speakers, that will be located at the opposite ends of the cage. This enables the music to be equally distributed in the cage and can ensure that the result is unbiased. The music may be more audible in certain areas if only one speaker is used.

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APPENDICES

Appendix A: Ethogram prepared to record the behaviour of the tigers

Subject:

Date:

Simulation:

	Behaviours																		
	Active										Resting						Stereotypic		
Time	Alert	Aggression	Clawing	Drinking	Feeding	Scent Marking	Smelling	Stalking	Walking	Vocalisation	Grooming	Laying on back	Resting awake	Roll over	Sitting	Sleeping	Yawning	Pacing	Walking in circles	Over-grooming
12:00																				
12:10																				
12:20																				
12:30																				
12:40																				
12:50																				
13:00																				
13:10																				

Appendix B: Normality test among the behaviours

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Active_control	.363	4	.	.733	4	.027
Resting_control	.326	4	.	.813	4	.128
Stereotypic_control	.275	4	.	.840	4	.194
Active_enrichment	.261	4	.	.955	4	.749
Resting_enrichment	.233	4	.	.969	4	.836
Stereotypic_enrichment	.325	4	.	.789	4	.083

a. Lilliefors Significance Correction

Appendix C: Paired sample statistics of the behaviours

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Active_control	128.7500	4	28.81406	14.40703
	Active_enrichment	105.5000	4	52.94966	26.47483
Pair 2	Resting_control	177.2500	4	16.91892	8.45946
	Resting_enrichment	150.0000	4	23.35237	11.67619
Pair 3	Stereotypic_control	62.2500	4	14.86327	7.43163
	Stereotypic_enrichment	45.2500	4	14.50000	7.25000

Appendix D: Paired sample tests of the behaviours

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Active_control - Active_enrichment	23.25000	59.97430	29.98715	-72.18249	118.68249	.775	3	.495
Pair 2	Resting_control - Resting_enrichment	27.25000	15.19594	7.59797	3.06986	51.43014	3.586	3	.037
Pair 3	Stereotypic_control - Stereotypic_enrichment	17.00000	27.86874	13.93437	-27.34538	61.34538	1.220	3	.310

Appendix E: Tigers selected in the study

Jay

Sungkai

Zanah

Stacy

Appendix F: IACUC Approval

PEJABAT TIMBALAN NAIB CANSELOR (PENYELIDIKAN DAN INOVASI)
OFFICE OF THE DEPUTY VICE CHANCELLOR (RESEARCH AND INNOVATION)

INSTITUTIONAL ANIMAL CARE AND USE COMMITTEE

Date:	01st August 2023
AUP No.:	UPM/IACUC/AUP-U036/2023
Project Title:	Effect of Auditory Enrichment to the Stereotypic Behaviour in Captive Malayan Tigers (*Panthera tigris jacksoni*)
Principal Investigator:	Dr. Azlan Che' Amat
Members:	Assoc. Prof. Dr. Hafandi Ahmad, Dr. Zubaidah Kamaruddin, Liew Jo Yee.
Attending Veterinarian:	Dr. Azlan Che' Amat.
Committee Decision:	The committee has reviewed and approved the proposed animal utilisation protocol, subject to relevant permit and/ or owner's consent.
Project Classification:	Chronic
Category of Invasiveness:	A
Source of Animals:	**Department of Wildlife and National Parks (PERHILITAN)** Peninsular Malaysia, National Wildlife Rescue Centre, Sungkai, Perak.
Number of Animals Approved:	10 Tiger
Housing:	National Wildlife Rescue Centre (NWRC), Sungkai, Perak.
Duration	01st August 2023 – 30th December 2023

Ethical approval is required in the case of amendments to the approved animal utilisation protocol (AUP). Please apply using Form 105. Kindly submit a final/annual report (Form 106) upon study completion, or before expiry of approval.

PROF. DATO' DR. MOHD AZMI MOHD LILA
Chairman
Institutional Animal Care and Use Committee
Universiti Putra Malaysia

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