UNIVERSITI PUTRA MALAYSIA

MALAYAN TIGER (*Panthera Tigris Jacksoni*) RESPONSE TOWARDS COLOURS AS VISUAL ENRICHMENTS

NUR SYAZA SYAFIQAH BINTI SAIFUL IZAM

Ip
FPV 2017 21

MALAYAN TIGER (*Panthera Tigris Jacksoni*) RESPONSE TOWARDS COLOURS AS VISUAL ENRICHMENTS

NUR SYAZA SYAFIQAH BINTI SAIFUL IZAM

A project paper submitted to the

Faculty of Veterinary Medicine, University Putra Malaysia

In partial fulfilment of the requirement for the

DEGREE OF DOCTOR OF VETERINARY MEDICINE

University Putra Malaysia

Serdang, Selangor Darul Ehsan

MARCH 2017

CERTIFICATION

It is hereby certified that we have read this project paper entitled "Malayan Tiger (*Panthera tigris jacksoni*) response towards colours as visual enrichments", by Nur Syaza Syafiqah binti Saiful Izam 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 – Project.

DR. INTAN SHAMEHA ABDUL RAZAK

DVM (UPM), PhD (UPM)

Senior Lecturer,

Faculty of Veterinary Medicine,

University Putra Malaysia

(Supervisor)

DR. HAFANDI AHMAD

BACHELOR OF SCIENCE (UPM), M.S (UPM), PhD (La Trobe)

Senior Lecturer,

Faculty of Veterinary Medicine,

University Putra Malaysia

(Co-Supervisor)

DR. TENGKU RINALFI PUTRA TENGKU AZIZAN

BACHELOR OF APPLIED SCIENCE (KUSTEM), M.S. (UKM), PhD (CANTERBURY)

Senior Lecturer,

Faculty of Veterinary Medicine,

University Putra Malaysia

(Co-Supervisor)

DEDICATION

This project paper is dedicated to Allah S.W.T, who has created me and made all things possible and successful in my life,

To my family and my parents who gave me supports and unending love from far,

My friends for staying at my side in time of happiness and sadness,

And to all my teachers who have committed themselves towards the noble cause of education.

ACKNOWLEDGEMENT

I would like to express my highest gratitude to Allah S.W.T and to all those who directly and indirectly helped me in completing this paper.

Firstly, I would like to thank my supervisor, Dr.Intan Shameha who gave me enormous amount of support from the beginning till the end of this project other than for lending me her wisdom, time, expertise and guidance to complete the project and this paper.

To my co-supervisors, Dr Hafandi Ahmad and Dr TengkuRinalfi for giving me their endless support and encouragement to make this project a successful one.

Special thanks to Dr Zubaidah, veterinarian in NWRC Sungkai, Encik Azhar, Encik Kuhafizi and staffs in NWRC Sungkai for lending me their strength and assisting me in conducting my project in NWRC Sungkai.

Gratitude to my classmates of DVM 2017 and my best friends for assisting me directly and indirectly in completing this project with special mention to Siti Syahadah Saad, Nur Izzati Aman and Nur Atirah Kairol Anuar.

Last but not least, to my beloved dear family; my mother, my father, my sister and my brother for their endless love, support and courage throughout my studies.

CONTENT

LIST OF FIGURES

IST OF APPENDICES

LIST OF TABLES

ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan asas VPD 4999 – Projek.

TINDAK BALAS HARIMAU MALAYA (*Panthera tigris jacksoni*) PADA WARNA SEBAGAI PENGAYAAN VISUAL

Oleh

Nur Syaza Syafiqah binti Saiful Izam

2017

Penyelia: Dr.Intan Shameha Abdul Razak

Penyelia Bersama: Dr. Hafandi Ahmad, Dr Tengku Rinalfi Putra TengkuAzizan

Berdasarkan senarai dari IUCN, populasi harimau Malaya (*Panthera tigris jacksoni)* pada zaman ini berada di dalam kategori haiwan terancam secara kritikal. Dengan itu, untuk memulihara spesis yang unik ini, konsep pemuliharaan haiwan terancam haruslah dititikberatkan di Malaysia. Pengayaan persekitaran sentiasa digunakan dalam membaikpulih persekitaran di dalam kurungan haiwan yang ringkas sebagai mimic kepada persekitaran yang lebih kompleks di hutan liar. Warna merupakan salah satu pengayaan visual yang penting bagi spesis harimau terutama pada harimau di dalam kurungan yang di kelilingi dengan dinding yang dicat dengan warna. Namun, malangnya kurang kajian berkenaan dengan topic ini untuk spesis harimau dilakukan

pada masa lalu. Dengan itu, berdasarkan kajian yang dijalankan ini, tindak balas harimau pada warna-warna terpilih dapat diperhatikan dan hasil daripada kajian ini dapat digunakan sebagai asas bagi kajian pada masa hadapan. Dalam kajian ini, empat harimau Malaya (*Panthera t. jacksoni)* dan dua harimau campuran baka (*Panthera t. jacksoni* x *Panthera t. tigris*) dipilih dan diperkenalkan pada tiga warna yang berlainan (merah, kuning, hijau) di dalam kurungan yang tersedia ada. Tiga warna tersebut dilekatkan pada dinding kurungan harimau tersebut sebelum harimau yang terpilih dilepaskan ke dalam kurungan tersebut. Pemboleh-ubah seperti umur, jantina dan asal (lahir di hutan liar vs lahir di dalam kurungan) dikaitkandengan tindak balas harimau terpilih pada tiga warna tersebut dan dikira dengan menggunakan 'Independent T-Test'. Berdasarkan pengiraan menggunakan statistik, ia menunjukkan tiada kaitan diantara pemboleh-ubah dan tindak balas harimau pada tiga warna tersebut. Walaubagaimanapun, purata bagi setiap pemboleh-ubah menunjukkan hasil yang berlainan bagi setiap warna. Lima daripada enam harimau terpilih didapati menghampiri warna merah dahulu apabila harimau-harimau ini memasuki kurungan tersebut. Jumlah frekuensi dan jangka masa harimau-harimau tersebut berkomunikasi pada warna-warna tersebut dikira dan berdasarkan hasil kajian ini, warna merah mendapat jumlah frekuensi dan jangka masa yang paling tinggi berbanding dengan warna kuning dan hijau. Hasil kajian ini menunjukkan bahawa harimau lebih menunjukkan minat pada warna merah berbanding dengan warna kuning dan hijau.

ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfilment of the course VPD 4999 – Project

MALAYAN TIGER (*Panthera tigris jacksoni*) RESPONSE TO COLOURS AS VISUAL ENRICHMENT.

By

Nur Syaza Syafiqah binti Saiful Izam

2017

Supervisor: Dr. Intan Shameha Abdul Razak

Co-Supervisors: Dr. Hafandi Ahmad, Dr Tengku Rinalfi Putra Tengku Azizan

Malayan tiger (*Panthera tigris jacksoni*) population is under the category of critically endangered according to IUCN lists. In order to conserve this unique species in Malaysia, practicing conservation concept is vital where the tigers are usually kept in captivity. Since the enclosure has simple environment design compared to the complex environment in the wild, environmental enrichment is commonly used for their welfare and health. Colours are one of the important visual stimulation for tigers in captivity since the enclosure is surrounded with walls but unfortunately, less research was done on this matter for this species. From this study, we are able to observe the response to the colours in this species and relate it with past research, which then can

be used for future research. In this study, four Malayan tigers (*Panthera t. jacksoni*) and two mix breed tigers (*Panthera t. jacksoni* x *Panthera t. tigris*) were chosen and introduced to three different colours (red, yellow, green) in their enclosure. Three colour papers (one paper for each colour) were pasted on the wall of the enclosure before releasing the tiger into that enclosure. The association between age, gender, and origin (wild vs born in captivity) of *Panthera tigris* with their responses towards the colours were calculated. From this study, Independent T-test was used. There are no significant differences ($p>0.05$) between the classes (age, gender, and origin) and the three colours. However, the mean for each class responses varies towards the colours. Five out of six tigers were initially approached to red colour before other colours. Total bouts and duration the tiger in contact with the three colours were calculated and results showed the tigers made contact more frequent and longer duration towards red colour paper. These results suggest that tigers showed more interest towards red colours compared to yellow and green colour.

1.0 INTRODUCTION

Tiger (*Panthera tigris)* is the largest living cat in the world according to Sunquist, 2010 where male tiger is usually larger than female but tigers from tropical are usually smaller compared to that in temperate countries. *Panthera tigris jacksoni* is one of other species of tiger that was recognized in 2004 as Tiger of Peninsular Malaysia, which is also known as The Malayan Tiger (IUCN, 2016). Malayan tiger (*Panthera t. jacksoni*) is currently classified as critically endangered category species, which means this species is in high risk of getting extinct in the wild. Thus, conservation of this species in Malaysia is vital to prevent from extinction.

Zoo Parks, Sanctuary and Conservation centre are the examples of captivity to conserve this species with their welfare and health being taken care of appropriately. Thousands of wildlife are being kept in captive with the purpose not only for conservation but also for research, education and recreation (Pitsko, 2003). However, there are limitations in captive environment which will usually affect their normal behaviour. Swaisgood *et al*. (2013) stated that, compared to captive environment, natural environment is more complex which needs physical and cognitive demands on the animal to survive. In order to make the captive environment more complex, environmental enrichments are commonly used in the captivity institutions.

Environmental enrichments can be defined as processes that are used to manipulate the captive environment to stimulate their psychological and physiological wellbeing (Sheperdson *et al*., 1998). Environmental enrichments can be classified into few categories but in this study, response to colours which is one of the visual enrichments are more focused on compared to other enrichments.

Tigers, like cats, have binocular vision which aids them to target and hunt their prey. They also have similarities in terms of the anatomical and physiological function of the eye. Retina layer comprises of numerous number of light receptive known as the rod and cone cells, and cats have more rods which give better low-light vision than cones that contributes to colour vision (Annabell, 2001).

There are numerous studies on colour visions in domestic cats but there are fewer studies on this field in specifically big cats such as tigers. There is still a debate whether felids are dichromatic or trichromatic animal until today, thus this study could be used as a baseline for further study in future. Since colours plays an important role in improving the mood of the tigers (Well, 2009) and to prevent depression and frustration to the animal, it is vital to know how the tigers' response to colours. The objectives of this study are:

a) To observe the behaviour of *Panthera tigris* to red, yellow and green colours.

b) To measure the association between age, gender, duration in captive, and origin (wild vs born in captivity) of *Panthera tigris* with their responses towards the colours.

b) To study the relationship between the duration in contact with the colour and frequency in contact with the colour (bout) with the red, yellow and green colours.

By the end of this study, we would be able to observe different responses towards red, yellow and green colours depending on different classes. We would also

be able to measure the association between the variables in this study as well as to study which colour that most of the tiger's response based on the frequency (bouts) and duration they made contact with each colour.

2.0 LITERATURE REVIEW

Tigers usually spend most of their time and energy in hunting for food according to Sunquist (2010). However, being in the captivity has limitations that can affect the behaviour of the animal (Szokalski *et al*., 2012).Environmental enrichment is the most common practice implemented in a number of institutions to improve the captivity environment, making it more complex.

2.1 Types of enrichments available

There are various types of enrichments that could be used as environmental enrichment to tigers in captivity that can improve their welfare and health. It is categorized as feeding manipulation, tactile, structural, sensory, social and cognitive enrichments (Maple & Perdue, 2013). Since tigers are highly territorial against their area, sensory enrichment such as olfactory stimulation, auditory stimulation and visual stimulation that triggers their senses are most commonly used as environmental enrichments in captive tigers.

2.1.1 Olfactory Stimulation as Environmental Enrichments

There are many ways in stimulating the olfactory sense of tigers such as smearing spices, faeces of prey animals or substrates from other enclosures which could stimulate their natural territory behaviours such as spraying (Szokalski *et al*., 2012). According to Skibiel *et al*. (2007), the introduction of few spices in six felid species (tigers are included as well) causes decrease of pacing (stereotypic behaviour) and increase their normal natural active behaviour. There was another studies done by Van Metter *et al*. (2008) who use zebra dung and scented squash as enrichments for

tigers with the result of increasing the tigers' behavioural diversity (Szokalski *et al*., 2012).

2.1.2 Auditory stimulation as environmental enrichments

There are various examples of auditory stimulation as enrichments depending on the species of the animal and the response to it varies as some animal may shows fear and stress as a response to it. Others may have positive response where there is a decrease in their stereotypic behaviour frequency. For example, Wells (2009) stated that, Markowitz *et al*. (1995) discovered that a female leopard showed great reduction in frequency of the stereotypic behaviour after being introduced to prey sounds from a computerized device.

Other than the sounds of preys or nature sounds, there were few studies done as well on classical music where the response also varies depending on the species. For example, Wisniewski (1977) stated that cattle are more readily to enter the milking parlour under the influence of country music compared to rock n roll music. Wells (2009) also stated that there was reduced of stereotypic behaviour in Asian elephants after the introduction of the classical music. Further studies need to be done to identify specifically which auditory stimulation is enriching as there are possibilities where the auditory stimulation could cause more harm than cure to one particular species.

2.1.3 Visual Stimulation as Environmental Enrichments

Visual stimulation enrichments that can be used vary from the surrounding enclosures, colours to improve the animal's mood or by using props such as television and mirrors (Wells, 2009). Nowadays, there are more visual enrichments are done

compared to back then. It is difficult to plan enrichments plans to this felid due to its behaviour of getting bored with the same items, thus broad studies on visual stimulation that was not commonly practised should be done.

Colours are known to have great effects to humans psychologically, emotionally, and in cognitive functioning. For that, colours play a role as one of the visual enrichments especially to animals that are kept in captivity. Some species have an aversive response towards certain colour such as red and shows preference to cooler colours such as blue and green (Wells,2009). This may be due to their eye anatomical and physiological characteristic besides than their natural instinct as a prey or predator. For tiger species (*Panthera tigris*), there were studies stated that tigers like other cats, have poor colour vision and can only recognised blue, yellow and slight green colour (Annabelle, 2001). Frustration or curiosity may occur to the animal when facing with unrecognised or unidentified colour (Wells,2009), thus identifying which colour have better response from the tigers is vital to prevent depression, anxiety and stress which could affect the tiger's health and welfare.

2.2 Relations between felids eye anatomy and physiology with colours.

Tigers (*Panthera tigris*) like cats, their eyes are directed forward making them having binocular vision and with the eye bulge, they are able to have a wide angle view (Annabelle, 2001).Cats have better low-light vision compared to human due to its anatomical features which include their elliptical eye shape, larger cornea and a layer that absorb more light known as tapetum lucidum (Ghose, 2013) (See Figure 1 in appendix I). Besides than those anatomical features, cats also have more rods cells that enable them to see under low light condition. Other than the rod cells, cats also

have cone cells which enable them to recognise colours. However, there is lesser number of cone cells in cats compared to that in human which makes human have better colour vision than cats (Ghose, 2013; Annabelle, 2001)(See figure 2 in appendix I).

There were few studies on cats colour visions and some scientist believes that cats are dichromatic and some believe that cats are trichromatic (Jacob, 1993; Kleber *et al*. 2003). These studies were done using behavioural and physiological experiment method. Jacob (1993) stated that, according to Wienrich & Zrenner (1983), cats have two types of cone which have peak sensitivity at 445-455nm and 555nm each, thus conclude that felids are dichromatic animal. However, Kleber *et al*. (2003) mentioned that, based on electrophysiology experiment done by Ringo *et al* (1977) and Crocker *et al*. (1980), there is another input from another photoreceptors that has peak sensitivity of 500nm, which usually is the rod cells that are not used in colour vision. In order to distinguish if the 500nm photoreceptor is used in colour vision or not, Kezeli *et al*. (1987) did a behavioural experiments and came up with a debate that the photoreceptor that has peak sensitivity of 500nm are cone cells but rods cells still can't be ruled out (Kleber *et al*., 2003). Therefore, more studies need to be done to classify if cats are dichromatic or trichromatic.

2.3 Colour recognition in felids

Most scientists believe that cats are dichromatic. Based on the behavioural and physiology experiments done in the past, the result support the fact that cats have two types of cone cells. One type of cone cells has peak sensitivity of 445-455nm (Jacob, 1993; Kleber *et al*., 2003) which indicates that cats may recognize blue colour

that has wavelength of 450 – 500 nm. The other type of cone cell has peak sensitivity of 555nm (Jacob, 1993; Kleber *et al*., 2003) which indicates that cats may recognize greenish-yellowish colour range. However, they could not recognize red colour due to lack of a type of cone cells that have peak sensitivity of red's light wavelength (See figure 3 in appendix I). However, according to Drake (2013), cats are able to slightly recognise green in colour.

2.4 Factors affecting tigers' response to the visual enrichments (colours)

2.4.1 Effect of age in response to the colours as visual enrichments

According to Pitsko (2003), from her study about effects of captive environment on tiger behaviour, she stated that elder animals rest more and less active compared to younger tigers especially the young tigers. However, that doesn't prove that they do not enjoy the presence of enrichments in their enclosure as Pitsko observe that the elder tigers did play and tear the boxes (enrichments) once it was introduced to them. The veterinarian in NWRC Sungkai (Dr Zubaidah), did mention that elder tiger might have vision problem due to their old age which also may be one of the reason why they lose their interest on the colour papers.

2.4.2 Effects of colour response against the origin of the tigers

There were no significant facts in regards that wild tigers and tigers that are born in captivity need different type of enrichment. There are also no significant facts about the differences in their vision for those born in the wild and that in captivity. However, according to the experienced staffs who have been working in NWRC Sungkai for more than 3 years stated that usually there is no difference in response to visual enrichments between the two categories except for the time when the tigers

become more active is different (Kuhafizi, 2016). He also stated that tigers who are born in the wild such as Scarface and Yeop are more active at night compared to during day time since these tigers usually show response to the provided enrichment items at night. This statement can be supported by another statement by Szokalski *et al*. (2012) who said that wild adult tigers usually spend most of their day time resting and patrolling instead of being active which is different compared to those born in captivity.

2.4.3 Visual enrichment response against different gender

Male is more territorial and solidatory compared to female, especially towards other male tigers due to reproductive or breeding purpose (Allen *et al*., 2015). Due to this, male felids usually sprayed (scent marking) to alert other tigers for his presence in that area (Allen *et al*., 2015). Dehase (1997) stated that felids do scent marking due to few reasons and one of it is due to triggering stimuli such as presence of activating mark (induced with odours) and activating spot (induced with soft surface and easy to knead items).

3.0 Materials and methods

3.1. The animals and the captivity

A total of six individual tigersfrom National Wildlife Rescue Centre (NWRC) Sungkai were chosen as the subjects in this study. Out of the six tigers, four of them belong to Malayan tiger subspecies (*Panthera tigris jacksoni*) while the other two belongs to a mix breed subspecies with unknown subspecies. These tigers were chosen based on the characteristics that are related to the variables of this study which are age, sex, and origin. Each tigers have different history from their past. Table below summarize the data on the tigers.

Name	Age	Gender	Origin
Scarface	19 years old	Male	Wild
Yeop	>10 years old	Male	Wild
Sungkai	2 years old	Male	Captivity
Chindai	2 years old	Female	Captivity
Siti	11 years old	Female	Captivity
Charlie	11 years old	Male	Captivity

Table 1: The characteristics of the selected tigers

Each tigers have different enclosures where they were placed singly in one enclosureexcept for a young tigress who shares the same enclosure with the mother occasionally. Each enclosure have different layout with different kind of enrichments such as tree barks, table-like furniture made from tree bark and a sink for water consumption. Sometimes they were released out from the enclosure to an open wide space compound with varies plants planted there that mimics a jungle particularly

during the cleaning and delivery of food. The duration of them to be in that open enclosure varies depending on the workers and the feeding schedule. These tigers were usually fed at three in the evening with chicken, frozen meat or fresh meat depending on their feeding schedule.

3.2 The variables used in the study

There are three main variables that are focused on and relate it with three different colours (red, yellow,green) in this study. One of the variables is age which consists of young and adult tigers. The young tigers are in the range of 1 to 10 years old while the adult age varies in range of 11 to 19 years old. Next variable is sex which consists of female and male tiger. Four out of the six tigers were born in captivity while the other two were captured from the wild which is the next variables in this study (origin). The relationship between the variables on the three colours which are red, green and yellow was calculated.

3.3 The experimental condition

In this study, three different colours were used as visual enrichments which are red, yellow and green colour. These colours were chosen based on the past research and literature on how felids could distinguish yellow and green colour but not for red colour. Three colour papers where each represents each colours were pasted against the wall in the enclosure (See appendix II). The location on where these papers were pasted depends on the layout of the enclosure with the aim to make sure the tigers can see the three colours at once when they enter the enclosure (Fig. 4). Camera was set up for each enclosure before the introduction of the colour papers to the tigers to

observe the tiger's response on the colours. This behavioural observation and recording occurred for three hours which started at noon and ends in the evening.

Figure 4: The layout of one of the enclosure in NWRC Sungkai

3.4 Data collection

In this study, each individual was recorded in the afternoon for three hours from 12 noon to 3 p.m. and the data on the response of the tiger towards each colour was recorded every 10 minutes with interval of 2 minutes which is donein other published methodologies (Pitsko, 2003; Shepherdson *et al*., 1993). This observation was done for 5 days consecutively.

The first response of the tiger towards which colour first after the introduction was noted. The frequency (bouts) and durations on how long did the tiger make contact with each colour papers were noted as well. The bouts can be described with

how frequent the tigers make in contact with the colour papers while durations can be described with how long did the tiger make in contact with the papers using second unit. Making contact with the items in this study includes responses such as sniffing, touching, biting, chewing, licking, playing and spraying on the papers.

3.5 Data analysis

Based on the data collected, total bouts and duration on how long the six tigers make contact with each colour paper was calculated. Other than that, total bouts and durations for each colour according to different variables which are age, sex, and origin were also calculated. For each variable, the bouts and duration on each colour was analysed and compared with mean value.

In this study, Independent T-test is used to calculate the association between the dependent variables (bouts and durations spent on the colour papers) and the independent variables (age, gender, origin, duration). Independent T-Test is selected since the data collected are categorical and the association between each classes and the colours are calculated to identify if there is significance difference in these different classes towards the three colours. The differences were considered statistically significant at $P<0.05$.

4.0 Result

4.1 Total bouts and duration the tigers made contact with the colours (red, yellow, and green)

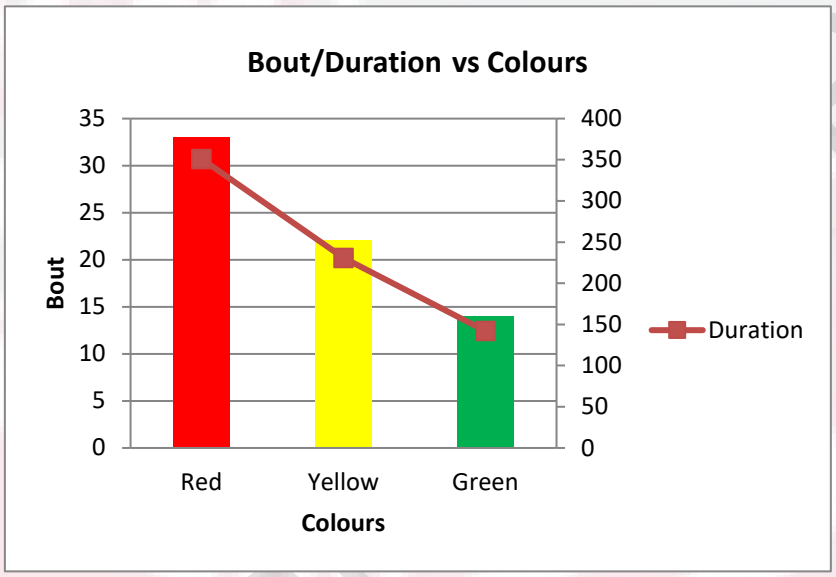


Figure 6: Total bouts and duration the tigers made contact with the red, yellow, and green colours

The graph above represents the total bouts and duration the six tigers made contact with the colours. From that, red colour have the highest bouts and durations which are 33 bouts and 351 sec respectively, followed by yellow with 22 bouts and 231 seconds duration and finally green colour with 14 bouts and 142 seconds duration.

4.2 Mean comparison and association between ages and the bout / duration the tigers spent on the red, yellow and green colours

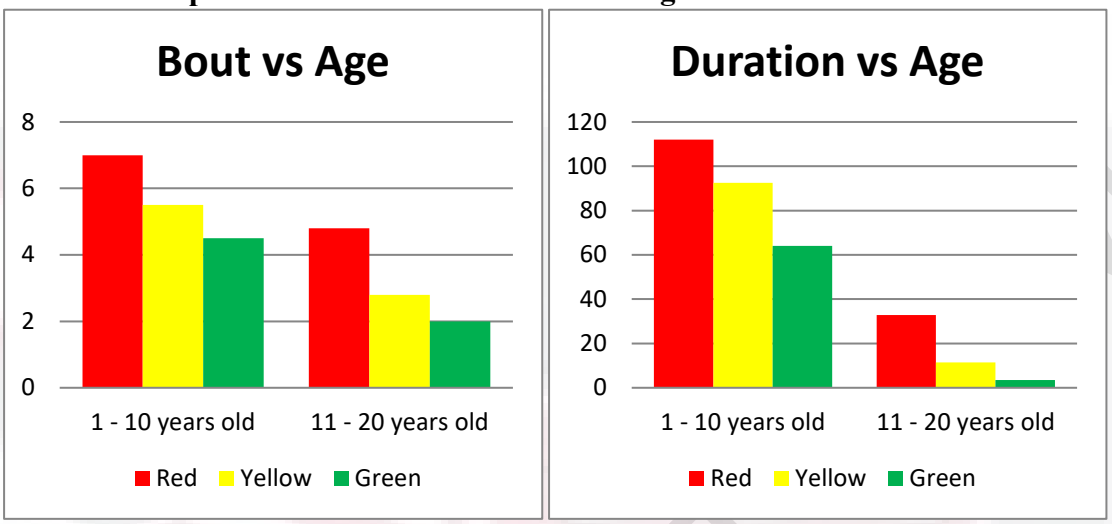


Figure 7: Mean comparison and association between age and the bout / duration the tigers spent on the red, yellow and green colours

Based on the graph shown, both groups of age made contact with red colour more frequent and longer compared to other colours but tigers from 1 – 10 years old group spend more time on the colours compared to the other group, especially red colour. However, there was no significant difference between the 1 – 10 years old and 11 – 20 years old groups towards giving response to each colour.

4.3 Mean comparison and association between gender and the bout / duration the tigers spent on the red, yellow and green colours

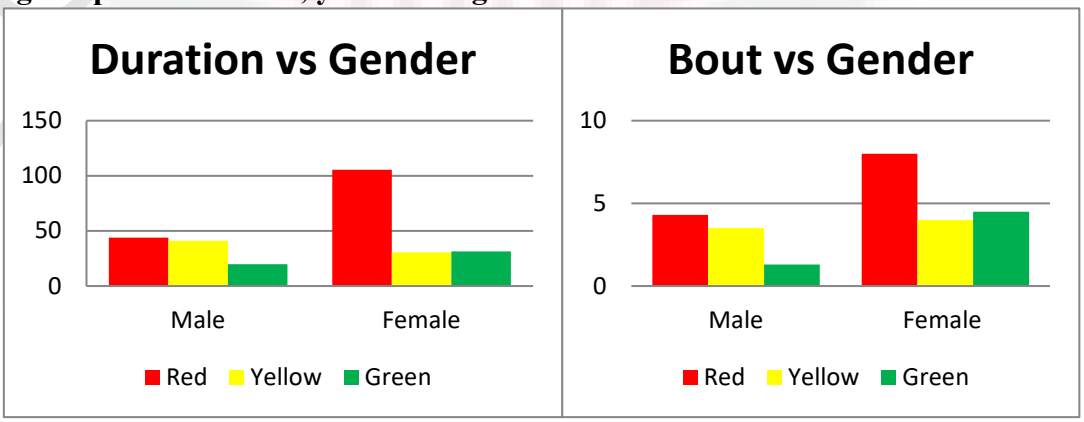


Figure 8: Mean comparison between gender and bout / duration the tigers spent on the red, yellow and green colours

Based on the graph, in both gender, the mean for bout and duration in giving response to red colour is higher compared to other colours. But, statistically there was no significant difference between male and female towards giving response to each colours.

4.4 Mean comparison and association between origin and the bout / duration the tigers spent on the red, yellow and green colours

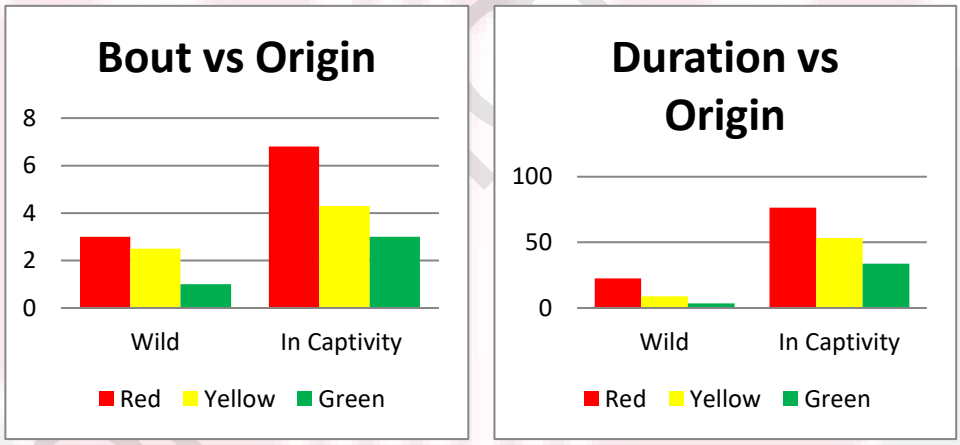


Figure 9 – Mean comparison between origin of the tigers and bout / duration the tigers spent on the red, yellow and green colours

Based on the graph shown, tigers that were born in captivity spent more time on the colours compared to that for tigers that were born in the wild. However, both tigers that were born in the wild and those that were born in captivity recorded highest mean (duration) in responding to red colour with mean, $\mu = 22.5$ and $\mu = 76.5$ respectively. Independent T-Test: No significant difference between tigers born in the wild and those in captivity towards giving response to the colours.

4.6 Scent-Marking behaviour

Two tigers (one male, one female) from six tigers showed scent-marking behaviour which is spraying towards the colour papers. Charlie, adult male mix breed tiger and were born in captivity did scent-marking (spraying) for five times on red colour paper and twice on yellow colour paper. Another tiger, Chindai, a young female Malayan tiger and was born in captivity sprayed on green colour paper once and once on the yellow colour paper.

4.7 Tearing off the colour papers from wall behaviour

Out of six tigers, two of the tigers torn all three colour paper from wall, two tigers torn red colour paper only from the wall and another two tigers did not torn any colour papers at all. Below is the result that stated which colour was torn by each tigers.

ID	First paper	Second paper	Third paper
Sungkai	Red	Yellow	Green
Chindai	Red	Green	Yellow
Charlie	Red	None	None
Siti	Red	None	None
Scarface	None	None	None
Yeop	None	None	None

Table 2: Colour papers torn by the selected tigers in NWRC Sungkai.

5.0 Discussion

Tigers usually spend large amount of time to hunt and get enough food in the wild (Sunquist, 2010). However, in captivity, pre-prepared food was given to the tigers which restrain their natural hunting behaviour which use not only a huge amount of time, it also used up large amount of energy. Simple environment in the captivity can induce boredom to the tigers. Boredom will lead to stress which then will affect their health physiologically and psychologically. This can be prevented with environmental enrichments that can make them spend more time and energy on the items. In this study, colour which is one of the visual stimulation enrichments are more emphasized compared to other enrichments. Based on the result, this study showed that the tigers gave more attention towards red colour in relation to bouts and duration spent in contact with the colour, compared to yellow and green colour. Not only that, scent-marking behaviour such as spraying and clawing were observed in few tigers as well.

5.1 Association between the classes (age, gender, and origin) towards response to the colours

5.1.1. Mean comparison between age and colours response

Younger tigers are more active and playful compared to the adult tigers. In the wild, young tigers usually start to learn to hunt by the mothers as early as five months old. The mother trains the cubs to hunt by playing hide and seek with them which aid in enhancing their hunting skills and to strengthen the bonds between the siblings (Hays, 2013). Since it is their nature behaviour to be playful and active, they easily get distracted with the three colour papers thinking that it is a play toys for them. In contrast to that, the older tigers prefer to rest than giving attention to the enrichment

items which was observed in a another study done by Pitsko (2003) where she stated that the elder tigers prefer to rest more. Both young and old group however showed more interest towards red colour compared to the other two colours (yellow and green).

5.1.2. Mean comparison between gender and colours response

Male tigers are more territorial compared to female tigers especially when they are placed together in a group in the same area. Male tiger territories usually expand over times depending on the amount of prey animals in the area (Lounsbury, 2012). They patrol more frequent to defend their territorial area which is why the male tigers made more contact with the enrichment items compared to female. However, the result from this study where female showed more interest towards the itemsis contradict to this facts. The females are born in captivity while two out of four males are born in the wild. This information may be the factor in obtaining such results. However, both male and female tigers show more interest towards red colour compared to the other two colours.

5.1.3. Mean comparison between origin and colour response

Both groups showed highest interest in red colour as well. However, between the two groups tigers born in the captivity made more contact with the items than those born in the wild. Tigers that are born in captivity are accustomed to the simple environment and to the presence of enrichments in their environment. They are also accustomed to being active during the day and rest at night due to the different environment compared to that in the wild where they need to hunt at night and rest during daytime (Sunquist, 2010). Tigers that are born in the wild are not accustomed

to the enrichment items resulting in reducing the interest towards the items. Instead, they are trying to adapt to the different environment. This is why tigers born in the wild hadless contact with the items compared to that in the other group. Another reason that could affect this result is the time when the study was conducted. Few experienced workers from NWRC Sungkai stated that tigers born in the wild are actually passive at day time which is different to that in tigers that are born in captivity. This statement may contribute to the reason why such results were obtained since this study was conducted at noon which is their natural resting time.

5.2 Relationship between duration and bouts for each colour

The total duration and bout for each colour were obtained and it showed that highest data was recorded forred colour, followed by yellow and finally green colour. This may be due to felids eyes anatomical and physiological structure. In felids eyes,there are lacking of a type of cone cells that have peak sensitivity of red colour wavelength of light (Drake, 2013). Therefore, the tigers approached red colour first before paying attention to the other two colours that they still can see were most probably due to curiosity.

5.3 Scent marking behaviour

Scent marking behaviour is a behaviour shown by tigers as a mechanism to defend their territorial areas (Smith *et al*., 1989). This is why scent marking behaviour is usually more frequentlyseen in males compared to females since male are more territorial than females. The most common scent marking behaviour observed in tigers are urine spraying and scraping or clawing by releasing secretions from their paws (Smith *et al*., 1989; Hays, 2013). This behaviour is another way of marking any

anonymous object that invades their territorial area, making the objects belongs to them. In this study, urine spraying and clawing wereobserved more frequently on the red colour compared to the other two colours. This might explained that they either feel threatened or discomfort with the red colour which induced them to mark that colour with their scent.

6.0 Conclusion and Recommendation

In conclusion, the tiger's response to red colour more and spend more time investigating the colour compared to the other two colours (green and yellow). This may be due to the lacking of the cone cells that has the peak sensitivity at red colour wavelength of light which causes the tigers not being able to distinguish red colour. As stated by Wells (2009), the tigers are more curious when facing with unrecognized items, thus supporting the fact that the tigers approach to red colour more due to its curiosity towards the colour. However, there is no association between the tiger's response to colours and the classes of tigers (age, gender and origin). This may be due to our limitations such as small sample size used in this study.

For future study, we would like to recommend to conduct this study at night time since tigers are nocturnal animal whom more active at night compared to day time. For this purpose, there are few different methods that can be used such as by using lights with different colour at night and consider to observe stereotypic behaviour before and after using the lights. Another method that can be used is by using a tempered glass with different colours instead of the papers which they could easily tear it. Last but not leastis to increase the sample size to increase the accuracy of this study.

REFERENCES

Allen, M., Wittmer, H., Houghtaling, P., Smith, J., Elbroch, L., &Wilmers, C. (2015). The Role of Scent Marking in Mate Selection by Female Pumas (Puma concolor). *PLOS ONE*, *10*(10), e0139087. http://dx.doi.org/10.1371/journal.pone.0139087

Annabelle, M. (2001). *Detailed information on the characteristics of the tiger: Eyesight*. *Lairweb.org.nz*. Retrieved 25 January 2017, from http://www.lairweb.org.nz/tiger/eyesight.html

Cat Color Vision Cat Vision Eyesight and How Cats See. (2009). Kittyshow.com. Retrieved 25 January 2017, from http://www.kittyshow.com/cat_color_vision.html

Dehasse, J. (1997). Feline urine spraying. *Applied Animal Behaviour Science*, *52*(3-4), 365-371. http://dx.doi.org/10.1016/s0168-1591(96)01135-5

Drake, N. (2013). *This Is How Cats See the World*. *WIRED*. Retrieved 26 January 2017, from https://www.wired.com/2013/10/cats-eye-view/

Ghose, T. (2013). *Feline Vision: How Cats See the World*. *Live Science*. Retrieved 26 January 2017, from http://Feline Vision: How Cats See the World

Hays, J. (2013). *TIGERS: CHARACTERISTICS AND HUNTING, MATING AND CUB-RAISING BEHAVIOR | Facts and Details*. *Factsanddetails.com*. Retrieved 8 February 2017, from http://factsanddetails.com/asian/cat68/sub432/item2499.html#chapter-8

Jacobs, G. (1993). The Distribution and Nature of Colour Vision amongthe Mammals. *Biological Reviews*, *68*(3), 413-471. http://dx.doi.org/10.1111/j.1469-185x.1993.tb00738.x

Kawanishi, K. 2015. *Panthera tigris ssp. jacksoni*. The IUCN Red List of Threatened Species 2015: e.T136893A50665029. http://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T136893A50665029.en. Downloaded on **25 January 2017**.

Kelber, A., Vorobyev, M., Osorio, D. (2003). Animal colour vision – behavioural tests and physiological concepts. *Biological Reviews ofthe Cambridge Philosophical Society*, *78*(1), 81-118. http://dx.doi.org/10.1017/s1464793102005985

Kuhafizi, (2017, January 10). Personal interview.

Maple, T. & Perdue, B. (2013). *Zoo animal welfare* (1st ed., pp. 95-112). London: Springer.

Pitsko, L.E. (2003) Wild Tigers in Captivity: A Study of the Effects of the Captive Environment on Tiger Behavior. Master's Thesis, Virginia Polytechnic Institute and State University.

Skibiel, A., Trevino, H., &Naugher, K. (2007). Comparison of several types of enrichment for captive felids. *Zoo Biology*, *26*(5), 371-381. http://dx.doi.org/10.1002/zoo.20147

Smith, D.J., McDougal, C., & Miquelle, D. (1989). Scent marking in free-ranging tigers,Panthera tigris. *Animal Behaviour*, *37*, 1-10. http://dx.doi.org/10.1016/0003-3472(89)90001-8

Sunquist, M. (2010). What Is a Tiger? Ecology and Behavior. *Tigers ofthe World*, *1*, 19-33. http://dx.doi.org/10.1016/b978-0-8155-1570-8.00002-5

Swaisgood, R. & Shepherdson, D. (2005). Scientific approaches to enrichment and stereotypies in zoo animals: what's been done and where should we go next? *Zoo Biology*, *24*(6), 499-518. http://dx.doi.org/10.1002/zoo.20066

Szokalski, M., Litchfield, C., & Foster, W. (2012). Enrichment for captive tigers (*Pantheratigris*): Current knowledge and future directions. *Applied Animal Behaviour Science*, *139*(1-2), 1-9. http://dx.doi.org/10.1016/j.applanim.2012.02.021

Wells, D. (2009). Sensory stimulation as environmental enrichment for captive animals: A review. *Applied Animal Behaviour Science*, *118*(1-2), 1-11. http://dx.doi.org/10.1016/j.applanim.2009.01.002

Zubaidah, (2017, January 11). Personal interview.

Appendix I

Figure 1: Comparison of human vision (above) and felid's vision (down) illustrated by Drake, 2013

Figure 2: Comparison between human colour vision and feline colour vision

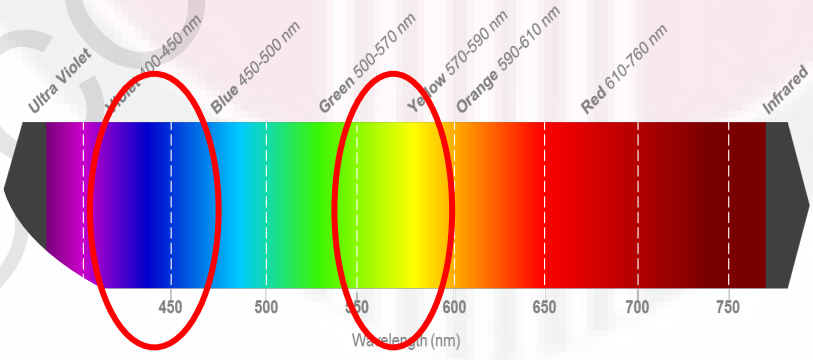
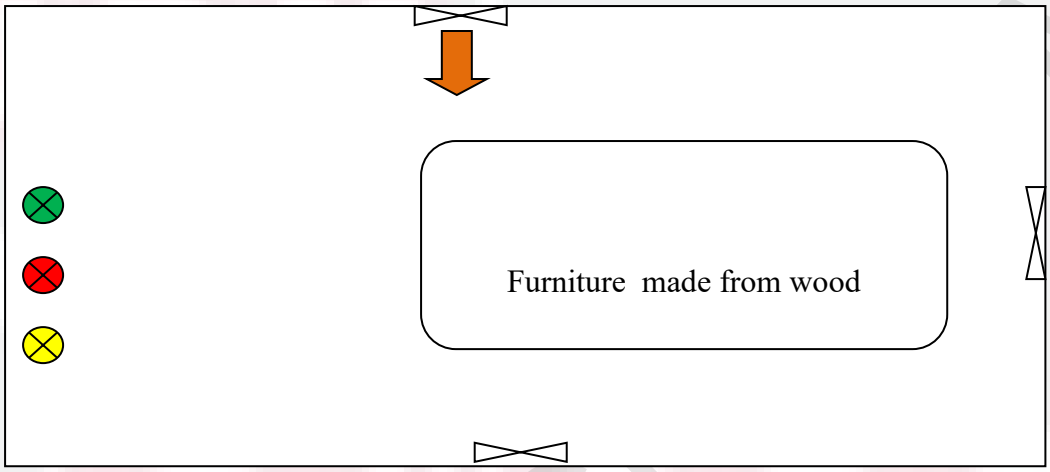


Figure 3: Peak sensitivity for wavelength of light that gives colour vision in felids (red circle)

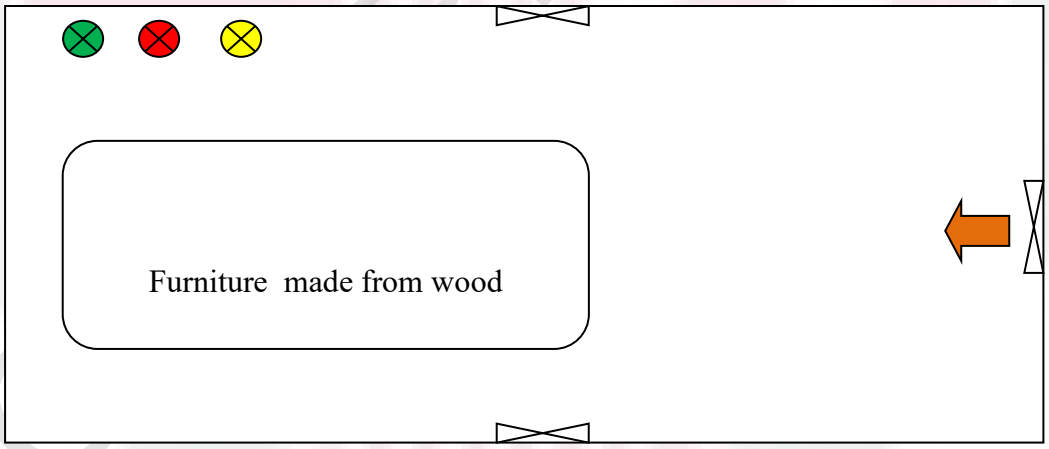
Appendix II

Figure 5: The enclosure layout for every tigers selected in this study

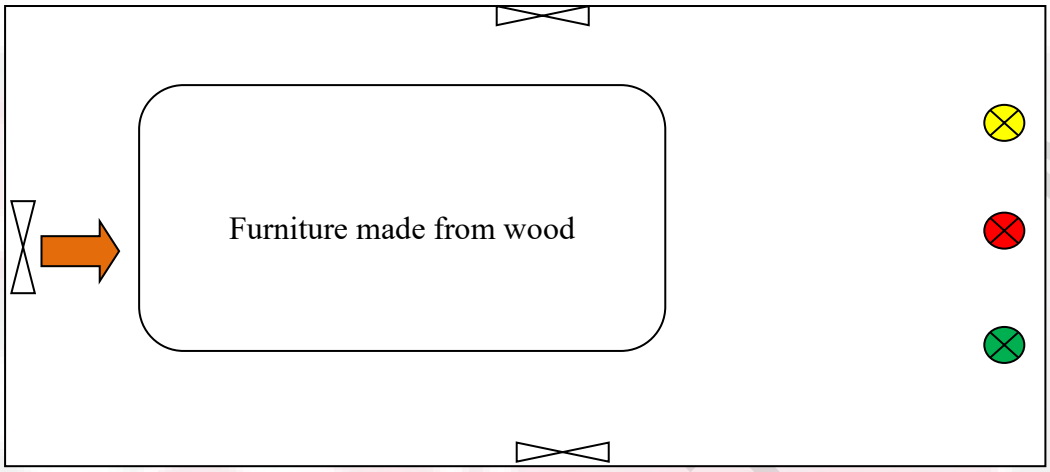
SCARFACE



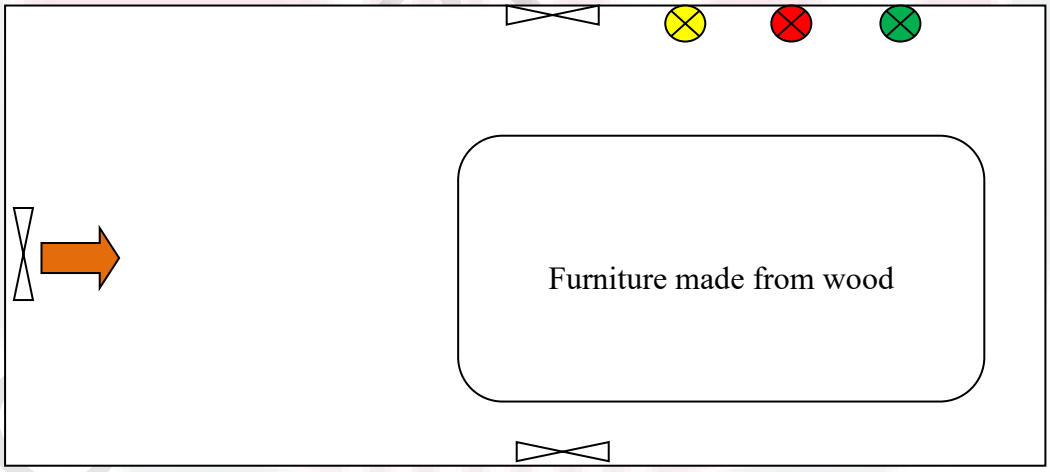
YEOP



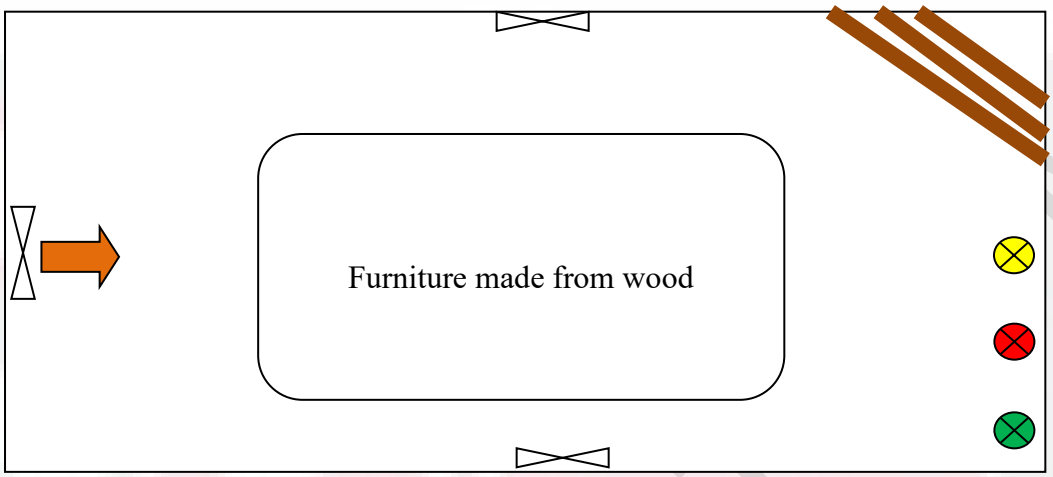
SITI



CHARLIE



CHINDAI



SUNGKAI