WESTERN SYDNEY UNIVERSITY

INVESTIGATING THE BEHAVIORAL RESPONSES TO ROUTINE HANDLING AND EXPOSURE TO NEW ENVIRONMENTS IN RABBITS

300914 FIELD PROJECT

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Abstract

In this study, observations were conducted ‘before’ and ‘after’ petting zoo excursions to investigate the influence of routine handling and environmental stimuli to behavioural stress responses within adult domesticated rabbits. Therefore the hypothesis for this study is that rabbits ‘after’ experiencing routine handling and a change in environment will display more stress-related behaviours then rabbits that have not experienced these factors. The study conducted involved 12 rabbits, with the control determined by 2 rabbits that were left unhandled and remained at the farm. The frequency of stress-related behaviours was determined through observations of study rabbits both ‘before’ and ‘after’ their petting zoo visitation. This allowed us to calculate the mean occurrence (times per rabbit) of each behaviour and compare between ‘before’ and ‘after’ observations. After the analysis of the results, we determined that observations of the rabbits ‘before’ leaving the farm displayed no stress behaviours; whereas a higher occurrence of stress behaviours occurred ‘after’ their return from petting zoo visitations. There was a significance in ‘grooming’ behaviour between both groups ($p = 6.56E-09$) (tab. 2), whereas the other behaviours were not significant ($p = 0.013344$; $p = 0.144928$) (tab. 2). Therefore, recommendations are made to further improve management strategies of the rabbits during the petting zoo excursion and at the farm. This would continue to minimise or eliminate stress responses and ensure the wellbeing of rabbits.

Introduction

The domestication of wild species for utilitarian purposes began 15,000 years ago whereby allowed for the development of the relationship between animals and humans (Ingold 2002). The introduced European rabbit (*Oryctolagus cuniculus*) first arrived in Australia with the first fleet in 1788 as domesticated livestock for meat (Department of Primary Industries, n.d.; NSW Office of Environment & Heritage 2018). As rabbits were first domesticated as a source of food (Irving-Pease *et al.* 2018), through selective breeding for specific traits such as size, colour, temperament and their behavioural response to humans (Agnvall *et al.* 2012), domestic breeds are kept and raised for their meat, fur and most commonly, as pets (Ferrand 2008).

Agnvall *et al.* (2012) stated that the success of the domestication of species is determined by the fear experienced by domesticated animals when humans are present. During the selective breeding process, to eliminate avoidable fear responses within domesticated animals, a central trait such as low fear for humans is favoured which results in the development of tameness (Csatadi *et al.* 2005). Domesticated animals with this trait tend to have a faster growth rate, low aggression, are easier to work with, and have lower stress levels. However, although these animals carry the trait, they can still exhibit fear and avoidance responses towards humans during interactions.

Similarly, according to Letty, Aubineau and Marchandeau (2008), domesticated rabbits have the ability to adapt well to their surroundings, especially in farming environments. Domestic animals have been bred selectively to reduce traits from their wild background. Like other animals, rabbits still possess traits associated with their wild ancestors such as social behaviours and therefore will express these behaviours when they are experiencing high stress levels (Lehmann 1991).

Psychological and environmental stresses are contributing factors which affect the health of rabbits and alter their psychology and behaviours. Rabbits may experience social stress from interactions with other rabbits and from the handling by humans (Mugnai *et al.* 2009), whereas physical stress including environmental factors such as change in climatic conditions and housing which can affect rabbits when experiencing new and unfamiliar surroundings (Verga, Luzi & Carenzi 2007). To minimise stress

responses, unnecessary stress in rabbits should be avoided as it further eliminates negative health consequences associated with stress (Poole 1997). Therefore, high standard husbandry and management practices including correct handling procedures are needed to meet requirements for animal welfare, thus minimising stress in rabbits. (Agriculture Victoria 2017)

This study is conducted for Noeline Cassettari from Kindifarm. First established in 1992, this mobile animal farm provides a hands-on and educational experience to learn about animals for people of all age groups. Through this observational study, we investigate the behavioural responses to increased handling and exposure to new environments in adult domesticated rabbits. Although management strategies are already in place at Kindifarm to minimise stress behaviours, including the use of snuggle sacs, positive reinforcement of trained behaviours and their access to shelter to hide during their petting zoo excursions, further research is needed to minimise and/or eliminate stress by reducing their fear when handled by humans.

Literature Review

Petting zoos provide members of the public the opportunity to directly interact with different animals. According to the Department of Environment and Energy (n.d), the purpose is for the educating people from all age groups about different animals and promotes positive one-on-one interactions between animals and visitors. However, Anderson *et al.* (2002) stated that although a positive relationship can be formed from one-on-one interactions between an animal and humans, some may display a defence response by running away or show aggression towards the human. However, Wells (2005) stated that a higher visitor density corresponds to non-aggressive animal behaviours which indicate that there is no difference in the effects of visitor density on the animal's welfare and behaviours.

However, this contradicts to Normando's *et al.* (2018) study whereby investigates the negative behaviour which corresponds to the increased presence of humans (visitor density) and the environment surrounding the petting zoo animals. Anderson *et al.* (2002) discovered that sheep (*Ovis aries*) pigmy goats (*Capra hircus*) displayed an increase in aggressive behaviours when there is a higher visitor density at petting zoos. Therefore a need for a retreat space is required to allow animals to have control of environment and human-animal interactions. However, there is limited research that has been conducted that suggests visitor density negatively impacts the behaviours of domesticated farm animals.

Psychological Stress and Husbandry Techniques

Psychological and environmental stressors contribute to the alteration of behaviours in adult domesticated rabbits, hence good management strategies and husbandry techniques are to be put in place to eliminate stress-related behaviours from handling and when exposed to novel environment. According to Bradbury and Dickens (2016), fear and stress behaviours are shown by rabbits when lifted off the ground to be handled due to their initial fear of close contact with humans. To minimise the stress response, the use of appropriate methods for holding rabbits allow for the improvement of human-animal interactions. Correct handling of rabbits increase their tolerance to handling by humans and creates a trusting bond between the handler and the animal. However, Normando *et al.* (2018) stated that when negative interactions and the incorrect handling occur, this may affect the animal psychologically and can

alter an animal's behaviour from the negative experiences. Therefore, by reducing the unnecessary handling and the frequency of rabbits handled during each session through environmental management, these effective management strategies are put in place to minimise the fear and stress when rabbits are handled by visitors.

Reduced fear is a result from when the selective breeding process is utilised whereby the individual with the trait for tameness is selected to be bred, as well as the human-animal interactions from a young age (Simm *et al.* 1996; Hemsworth 2003). For example, when adult laying hens have a lack of human interaction throughout its lifespan, the hen would have a much higher level of fear and stress towards humans. When hens experience this level of stress, it affects their behaviours and their egg laying productivity; thus suggesting the importance of regular handling of production chicks to reduce fear towards humans (Barnett, Hemsworth & Newman 1992; Jones & Waddington 1993).

Environmental Stress and Management Strategies

When an animal is placed within a new, unfamiliar environment, they tend to experience a lack of control within their surroundings. Beattie, Waler & Sneddon (1995) stated that he change in environment cause physical and social impacts on animals, thus affecting the animal's behaviour. When an animal experiences a lack of control over their environment, they tend to display aggressive behaviours or stress indicators such as hiding out of sight or fighting with other individuals.

To assist animals in reducing their stress within a new environment, Anderson *et al.* (2002) suggests a retreat space to allow the animal to settle down in its new surrounding and for the control of interactions with humans. This is demonstrated by the African pygmy goats (*Capra hirus*) whereby a large retreat space was provided within their enclosure when human-animal interactions occurred. This resulted in the goats displaying the least stress-related behaviours in contrast to the goats which had no retreat space during the study. Therefore, the setting of enclosure at petting zoo visitations involves good management strategies to assist in improving the wellbeing of domesticated farm animals, by also ensuring the Five Freedoms are met (Webster 2001), when animals experience increased human-animal interactions.

Early Handling of Animals

In addition, the fear of humans can also be further reduced through the handling of animals while they are young (Hemsworth 2003). By performing the technique of handling rabbits at a young age during their 'sensitive period', as they grow older they would experience less stress and fear when approached and handled by humans (Bilkó and Altbäcker 1999). This is supported by Csatadi's *et al.* (2005) study whereby rabbits that were handled one week after birth developed the capability to recognise humans using their olfactory system for smell and were more tame as adults than the control rabbits. This indicates that early handling of rabbits creates a positive long term impact on rabbits as adults to reduce stress.

Evaluation of Stress Indicators

In addition to discovering the causes of stress behaviours, it is highly important to utilise methods to evaluate stressors. Indicators are monitored to evaluate responses to stress situations whilst ensuring to consider the species' individual temperament (Genco *et al.* 1998). Behavioural indicators of stress identified from the handling of animals include the change in social, feeding and grooming behaviours. For example, in rabbits, stress induced behaviours also include aggression towards humans, excessive grooming, teeth grinding, lethargy and hunched appearance with ears flattened. Thus using behavioural identification methods for stress symptoms, we are able to understand how each individual animal interacts with the physical environments and their response to psychological stressors which can alter their behaviours.

Stress-related behavioural responses in adult domesticated rabbits can be altered when exposed to increased handling and new changing environments. However, with the understanding of the domesticated animal's responses to stimuli and implementing good management strategies to suit the species' needs during petting zoo visitations is essential to minimise or eliminate fear and stress when handled by humans within new surroundings; thus ensuring the health and wellbeing of the animals.

Research Methodology

This study includes the observation of 12 adult domesticated rabbits of various ages that are used by Kindifarm for petting zoo excursions over the study period. By conducting this research, we were able to determine the rabbits' stress behavioural responses to routine handling and regular changes in the environment.

Observational data collection

The study was accomplished through observations only and by recording any stress behaviours demonstrated by the rabbits before they leave the farm and when they return. The observations were held over a 6-week period, with 1 day of observations per week; thus totalling to 6 observation days throughout the study.

For this study, 12 adult domesticated rabbits are observed at the research site at Kindifarm, Dural. The rabbits at the site are housed in multiple extended enclosures (5m x 2m) which follows the guidelines for housing rabbits in Australia (Chave 2003). Each enclosure houses 4 rabbits of different breeds including the Netherland Dwarf rabbit, Ear-loped rabbit and the Rex rabbit. From the 12 rabbits observed for the study, the control of this study was determined by 2 rabbits in enclosure 4 where they were left unhandled and not taken out on petting zoo excursions during the observation period. Whereas rabbits from enclosures 1, 2 and 3 were handled multiple times each day by staff of Kindifarm and members of the public, and were exposed to a change in surrounding. The identification of each rabbit observed is based on their unique colouring and markings. Their description and accompanying photos was recorded in a data spreadsheet which allows for quick and easy identification of each individual rabbit.

Each rabbit, including the control rabbits, were observed 5 metres outside their enclosure for a total of 20 minutes per day for the 6-week period. By using a stopwatch to time each observation, an accurate time period for each observation was made.

Observations were made using the method of 'scan sampling', whereby the rabbits in each enclosure are observed and behaviours demonstrated by each rabbit are recorded at 1 minute intervals for a 10 minute period (total of 10 scans). This would occur before leaving the farm to their petting zoo excursion and following their return. An

acclimation period of 5 minutes before each observation will ensure the rabbits will not react to any human interference and enable the demonstration of natural behaviours. During each observation, behaviours observed from each rabbit were recorded onto an ethogram including stress-induced behaviours such as excessive grooming, digging, foot stomping, ears back, out of sight and rapid breathing (refer to table 1).

Table 1: Ethogram of expected rabbits' stress indicator behaviours displayed during observations.

Stress indicator behaviours:	Description:
Excessive grooming	Constant grooming over a long period of time
Out of sight	Not visible due to hiding under or behind objects in enclosure
Foot thump	Thumping of rear foot while in enclosure
Digging	Digging in the enclosure and into litter box
Ears back	Ears lying back flat against its head
Body Shake	Shaking of entire body
Rapid Breathing	Breathing faster than usual
Head shake	Shaking of only the head
Body shake	Shaking of whole body
Other	Other behaviours that are not listed in ethogram

Data analysis

After the observational period, the data collected were put into column graphs which would demonstrate the differences of behaviour occurrence between each treatment. A data analysis was also made using One-Way ANOVA on excel. This will determine the frequency of stress-related behaviours which correspond to routine handling of rabbits and the regular changes in environment. From the datasheets collected after all observations were completed, the mean numbers of times stress related behaviours that occurred within each study rabbit for each observational day over a 6-week

period is calculated. The results are then converted into column graphs, demonstrating the differences between the before & after increased handling and change in environment, as well as the course of change throughout the study period over time.

Justification of methods based on literature

Similarly to this research method, Balcombe, Barnard and Sandusky's (2004) study analyses the potential stress of laboratory rabbits associated with routine husbandry procedures including handling through physiological changes (such as heart rate, plasma concentrations of corticosterone), and using the observational technique to observe their change in behaviour. Although limited studies were found which focus on stress behaviours in domesticated rabbits, Seggie & Brown's (1975) study explores stress responses in rats when handled and exposed to novel stimuli, however this study focuses more on hormone changes when the rat is affected by a stress stimulus.

A study by Swennes *et al.* (2011) determines whether the increase in human handling could reduce stress within adult rabbits, thus the reduction of human-directed fear. Rabbits in this study were handled multiple times a day and a behavioural analysis were conducted which allowed for the comparison between the control rabbits and those which were handled throughout the study. These studies correspond to the research method used for this study to investigate behavioural responses in rabbits when exposed to increased handling and new environments.

Results

The mean number of times stress-related behaviours of 10 adult rabbits were determined through observations 'before' and 'after' their petting zoo excursion, which were held over 6 observation days. Figure 1 demonstrates the mean number of times the 'grooming' behaviour occurred within the study rabbits over the observational period. There was a trend for a lower occurrence of 'grooming' behaviour in rabbits in the control treatments and the 'before' treatment compared to the rabbits after the petting zoo excursion. Therefore, this trend is significant as the rabbits from the 'after' treatment demonstrated a significantly higher number of times the grooming behaviour occurred than the other treatments, with the level of significance of p-value = 6.565E-09 (tab. 2).

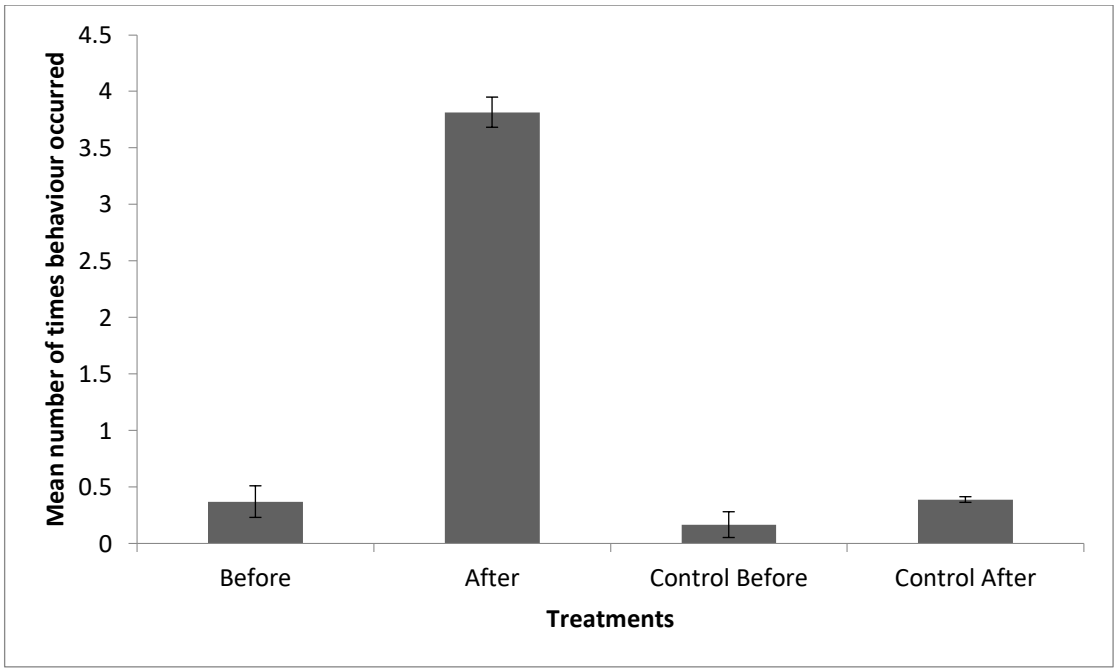

Figure 1: Mean number of times the 'grooming' behaviour occurred within study rabbits during each treatment at Kindifarm between 9th August – 13th September; with ± standard error

The mean occurrence of other stress-related behaviours including 'out of sight', 'foot thump' and 'digging' demonstrated a dramatic difference between behaviours and each treatment. These behaviours were only demonstrated by study rabbits 'after' experiencing routine handling and environmental stimuli from the petting zoo excursion, with no occurrence within other treatments (fig. 2). Within the 'after' treatment, the occurrence behaviours were significantly different from each other.

This is demonstrated through the ‘out of sight’ behaviour which is significantly higher with the level of significance of p-value = 0.0004691; whereas both the ‘foot thump’ and ‘digging’ behaviour had a significantly lower occurrence (p-value = 0.133437; p-value = 0.493322) (tab 2.). As well as this, a significant difference of behaviours between treatments is shown in the ‘after’ treatment, whereby rabbits only displayed the behaviours within this treatment. However, no behaviours occurred within the ‘control’ treatments and the ‘before’ treatment; thus this trend was significant.

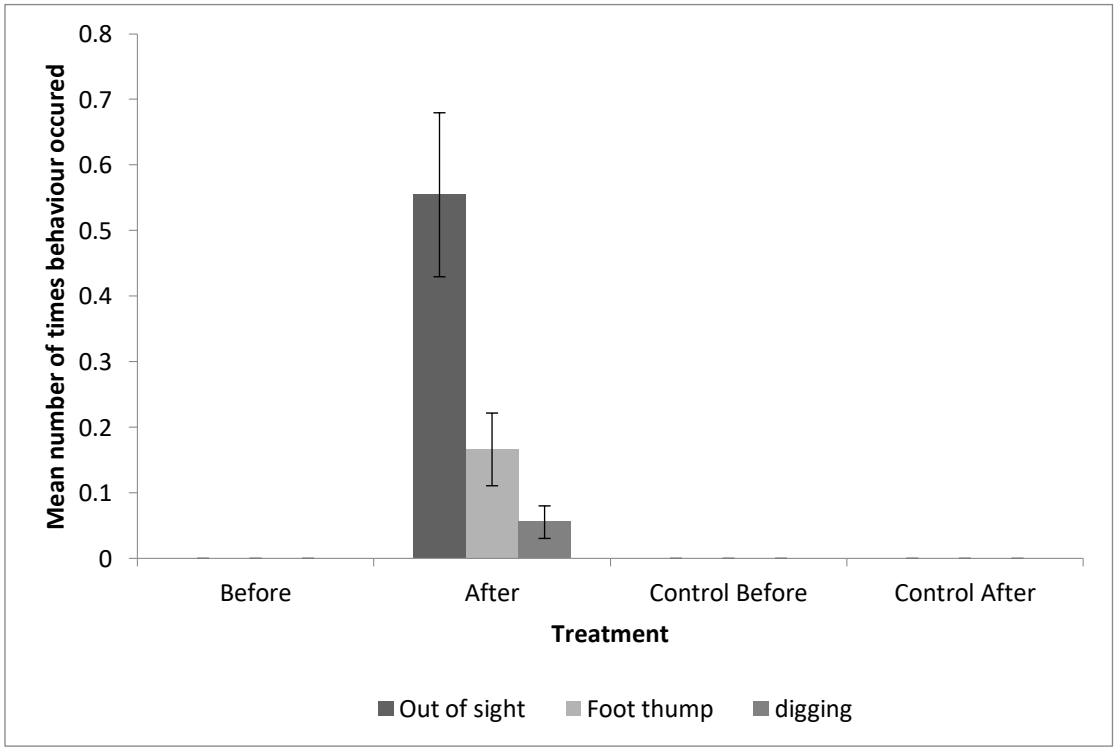

Figure 2: : Mean number of times the ‘out of sight’, ‘foot thump’ and ‘digging’ behaviours occurred within study rabbits during each treatment at Kindifarm between 9th August – 13th September; with ± standard error

One-way ANOVA was used to determine the significance of behaviours between rabbits ‘before’ and ‘after’ exposure to routine handling and environmental stimuli, as well as the mean occurrence of stress-related behaviours. This is demonstrated through the frequency of behaviours and p-value shown in table 2; thus allowing us to determine the significance between groups. Behaviours including ‘grooming’, ‘out of sight’, ‘foot thump’ and ‘digging’ all demonstrated a significant value between treatments (tab. 2).

Table 2: ANOVA values of stress-related behaviours within study and control rabbits of each treatment at Kindifarm between 9th August – 13th September.

Behaviour	***P-Value***	***F crit***
Grooming	6.565E-09	4.964603
Out of sight	0.0004691	4.964603
Foot thump	0.0133437	4.964603
Digging	0.0493322	4.964603

Discussion

The exposure of routine handling by humans and environmental changes influences the behaviour of rabbit species (Mugnai *et al.* 2009; Verga, Luzi & Carenzi 2007). By undertaking this study, we are able to investigate the stress-related behavioural responses of domesticated adult rabbits 'before' and 'after' experiencing routine handling and new environments, during their petting zoo excursions. Therefore, it is expected that when rabbits are exposed to these factors, the occurrence of stress-related behaviours will increase (Normando *et al.* 2018).

Following the 6 observation days over a 6-week period, the mean occurrences of set stress-related behaviours during each observation day were calculated. The results of rabbits 'after' the exposure to the routine handling and environmental stimuli showed that that rabbits displayed a significantly higher 'grooming' behaviour (e.g. licking of hands and feet) occurrence than the other treatments (fig. 1). This demonstrates a high level of significance in 'grooming' behaviour between treatments (p-value = 6.565E-09) (tab. 2); thus corresponding to our expected results. However, the mean occurrence of 'grooming' within the 'after' treatment significantly contrasts to the 'before' and the 'control' treatments whereby rabbits, which were unhandled and not taken to petting zoo excursion, displayed a significantly lower occurrence of the 'grooming' behaviour throughout each observation.

As grooming is generally demonstrated by rabbits for the purpose of cleaning themselves and extracting foreign objects from their fur (Albonetti, Dessí-Fulgheri & Farabollini 1991), Lincoln's study (1974) stated that it is common for rabbits to groom themselves several times a day to maintain hygiene. However, when rabbits continuously groom themselves over a long period of time, this acts as an indicator of increased stress within rabbits (Hansen & Berthelsen 2000). This occurs when rabbits experience social stress from handling by humans and other surrounding animals (Mugnai *et al.* 2009). Therefore, unlike the control and study rabbits 'before' routine handling and environmental changes, the higher occurrence of 'grooming' within the 'after' treatment has indicated a mild level of stress within the rabbits (Gispen and Isaacson 1981). Even though there was a significant difference between treatments, the mean occurrence of 'grooming' was still low enough to indicate that the rabbits

did not experience any stress as over-grooming did not occur within the 10 minute period.

According to Andrist's *et al.* (2012) study, rabbits that are experiencing stress tend to be 'out of sight' by hiding behind or under objects within their surroundings. This is demonstrated in figure 2 whereby the 'out of sight' behaviour had a significantly high occurrence within the 'after' treatment but did not occur within the other treatments; thus a significant difference of p-value = 0.0004691 between treatments. Verga, Luzi and Carenzi's (2007) study which further stated that signs of stress including 'foot thump' and 'digging' are displayed by rabbits experiencing a level of stress. This is demonstrated in figure 2 as we see that these behaviours only occurred within the 'after' treatment with a lower occurrence than 'out of sight' behaviour.

Similar to the occurrence of 'out of sight' behaviour, rabbits also did not display other behaviours including 'foot thump' and 'digging' behaviours within the 'before' and 'control' treatments. The continuous display of thumping behaviours is exhibited by rabbits undergoing stress and/or fear (Black & Vanderwolf 1969). However, it was determined that the low occurrence of the display of 'foot thump' behaviour in rabbits after the petting zoo visitation which had the possibility of not indicating stress, but was the demonstration of communication between the rabbits. This is supported by Randall's (2015) study whereby rabbits create low frequency vibrations by foot drumming which produces thumping patterns and signals for surround rabbits. Domesticated rabbits tend to have the ability to quickly adapt to changing environments (Letty, Aubineau & Marchandeau 2008; Khatun *et. Al* 1999). This is demonstrated through the low mean occurrence of the 'digging' behaviour which had a significant difference between each treatment (p-value = 0.0493322). Therefore, due to the significant differences of behaviours between treatments, the hypothesis is accepted.

These results have indicated the need to further improve existing management strategies at Kindifarm during petting zoo visitations to eliminate stress when handled by humans within changing environments.

Recommendations & Conclusions

In this study, observational data was collected and assessed to investigate the behavioural responses to routine handling and environmental stimuli in adult domesticated rabbits. Through observations of different behaviours that occurred 'before' and 'after' the petting zoo excursions, we were able to determine how the handling of rabbits and the exposure to new environments influence the stress levels which are demonstrated through stress-related behaviours. Through our results, we concluded that although there are extremely low levels of stress response occurrences from both groups, there is a higher occurrence of rabbits displaying stress behaviours 'after' their arrival from the petting zoo excursion. Thus, the handling by human and change in environment does result in a level of stress within the rabbits.

Although the results indicate good management practices of animals, it is highly recommended to further improve existing management strategies of the rabbits during their petting zoo visitations and at the farm. This would continue to minimise or eliminate stress responses in rabbits. Husbandry techniques to improve the health and welfare of the rabbits are to be implemented during visitations when children are handling the rabbits. These techniques include alternating between each rabbit for handling which would allow for longer break times between each holding of the rabbit. By reducing the frequency of rabbits handled during each session, this also allows rabbits to rest for a longer period and avoids unnecessary handling. While rabbits are resting, it is suggested that Kindifarm staff should conduct interesting activities (i.e. Bottle feeding, pellet feeding, and introduce larger animals). Not only would this improve human-animal interactions with different species, but also allow for rabbits and other smaller animals to have a break from handling. Although Kindifarm staff ensures that animals have a retreat space within the pen during visitations, it is also recommended to provide additional shelter (e.g. clean pet carrier) within the retreat space for added security. This would further reduce their stress levels, especially where there are many people present during petting zoo visitations.

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APPENDIX

One-Way ANOVA output

Grooming

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Grooming (face/feet) (Before)	6	2.222	0.370333	0.11692
Grooming (face/feet) (After)	6	22.889	3.814833	0.10693

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	35.59374	1	35.59374	318.0136	6.56E-09	4.964603
Within Groups	1.119252	10	0.111925			
Total	36.71299	11				

Out of Sight

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Out of sight (Before)	6	0	0	0
Out of sight (After)	6	3.444	0.574	0.076224

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.988428	1	0.988428	25.93482	0.000469	4.964603
Within Groups	0.38112	10	0.038112			
Total	1.369548	11				

Foot Thump

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Foot thump (Before)	6	0	0	0

Foot thump (After)	6	0.999	0.1665	0.018482

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.083167	1	0.083167	9	0.013344	4.964603
Within Groups	0.092408	10	0.009241			
Total	0.175574	11				

Digging

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Digging (Before)	6	0	0	0
Digging (After)	6	0.333	0.0555	0.003696

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.009241	1	0.009241	5	0.049332	4.964603
Within Groups	0.018482	10	0.001848			
Total	0.027722	11				

Ears Back

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Ears back (Before)	6	0	0	0
Ears back (After)	6	0.444	0.074	0.013142

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.016428	1	0.016428	2.5	0.144928	4.964603
Within Groups	0.065712	10	0.006571			

Total	0.08214	11

Body Shake

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Body Shake (Before)	6	0	0	0
Body Shake (After)	6	0.222	0.037	0.003286

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.004107	1	0.004107	2.5	0.144928	4.964603
Within Groups	0.016428	10	0.001643			
Total	0.020535	11				

Rapid Breathing

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Rapid Breathing (Before)	6	0	0	0
Rapid Breathing (After)	6	0.222	0.037	0.003286

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.004107	1	0.004107	2.5	0.144928	4.964603
Within Groups	0.016428	10	0.001643			
Total	0.020535	11				

Head Shake

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Head shake (Before)	6	0	0	0
Head shake (After)	6	0.222	0.037	0.003286

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.004107	1	0.004107	2.5	0.144928	4.964603
Within Groups	0.016428	10	0.001643			
Total	0.020535	11				