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The Role of Applied Behaviour Analysing in Zoo Management System for Animals

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Article History	Abstract
	This study examines the use of Applied Behaviour Analysis (ABA) in animal management systems in zoos with an emphasis on how well it enhances animal wellbeing. The goals of the study were comparing ABA-based approaches to conventional zoo management techniques and evaluating the effect of ABA on stress reduction in captive chimpanzees. Over the course of a year, information was gathered from a chosen group of chimpanzees, including baseline and post-ABA stress levels. Following the use of ABA techniques, the data from Table 1 show a consistent trend among the chimpanzees, suggesting a considerable reduction in stress levels. Strong evidence for the effectiveness of ABA in lowering stress levels in the chimpanzees was given by statistical analysis of the data (Table 2). With a high t-statistic of 8.25, the mean baseline stress level of 7.7 substantially decreased to 3.5 post-ABA treatments (p 0.05), emphasizing the significance of this reduction. With regard to reducing stress, Objective 2 compared ABA-Based and Traditional groups. Compared to the Traditional group, the ABA-Based method had a reduced baseline stress level, according to the findings in Table 3. The ABA-Based group showed a significant reduction in stress levels following ABA sessions, while the Traditional group also showed a reduction in stress levels, albeit to a lesser extent. Both strategies significantly reduced stress, according to statistical analysis (Table 4), with the ABA-Based strategy having a greater degree of statistical significance (p 0.05). This study concludes by offering empirical proof that Applied Behaviour Analysis is a useful method for enhancing animal wellbeing in the context of zoo management. The findings imply that when compared to conventional management techniques, ABA therapies can significantly lower stress levels in caged animals.
	Keywords: *Applied Behaviour Analysis (ABA), Zoo management, Animal welfare, Captive animals, Stress reduction.*

1. Introduction

Although the care for the animals is carefully documented, the Zoo in India was primarily established to amuse people. India is home to a rich range of animal species. They came to assume an important function in the upkeep of the natural world over time. The Zoo is dedicated to the cause of conservation. Because of the study that had been done to computerize the administration, maintenance, and ticketing of the animals, this task was rather straightforward. As a result, a database management program known as the "Zoo Management System" or "ZMS" was developed. This is a technology that can manage content on the web.

Figure 1: Conservation of zoo animals

Wild animals that are kept in captivity are zoo animals. They are kept in zoos for the purposes of research, education, and recreation in addition to conservation efforts. The manifestation of a phenotypic characteristic within the contextual context for which primary selection processes have moulded it, with the result being maximal, inclusive fitness, is what we refer to as behavior. The procedures that an animal goes through in order to react to stimuli in its surroundings are all a part of its behavior. Research on animal behavior conducted in captivity can yield useful insights on the physical and mental health, as well as the reproductive state, of the animal, all of which are essential for the species' continued existence. These studies involve the utilization of proper behavioral sampling methodologies in order to keep track of baseline behaviors (such as maintenance behaviors) or changes in instances (such as those that occur in response to environmental enrichments). A comprehensive knowledge of the phenotypic characteristics of a species involves a mix of extensive field research over an extended period of time with observations and tests conducted on the captive individuals of that species. Field studies have the benefit that they provide the formation of hypotheses that are grounded in reality; nevertheless, they suffer from the drawback that they do not permit the complete control of a large number of potential confounding variables. Therefore, research with animals kept in captivity are very significant because they provide the opportunity to conduct tests and observations that are not possible in the field. Experiments carried out on caged animals have a number of drawbacks, one of which is that their unnatural surroundings might result in deviant behaviour. In the context of zoos, the primary goals of behavioural research are often the collection of baseline information and the resolution of management issues. Both are necessary in order to understand the biology of animals and the role that conservation plays in maintaining their populations. This message provides an overview of the relevance of behavioural research in the care and breeding of zoo animals, as well as its role in management.

Figure 2: Breeding of zoo animals

The administration of zoos has undergone considerable changes throughout the years, developing into centers for conservation efforts, educational programming, and scientific investigation. Previously, zoos were just shown as examples of exotic creatures. Because of this change, the welfare and well-being of the animals have become of the utmost importance, which calls for a deeper comprehension of animal behavior as well as efficient management measures. Applied Behavior Analysis, or ABA for short, is a science that is evidence-based and methodical, and its primary application is in the field of human psychology. However, it has found an important place in the management of animals in modern zoos. The implementation of ABA in zoos goes beyond simple observation and the alteration of animals' behaviors; rather, it involves an all-encompassing strategy for better comprehending, enhancing, and preserving the lives of animals that are kept in captivity. This article examines the significant part that Applied Behaviour Analysis plays in the administration of zoos, shining light on its various uses, advantages, and consequences for the welfare and protection of caged animals. As we look more into the many facets of ABA inside zoos, it becomes abundantly clear that this scientific approach is crucial to the development of future policies for the responsible and ethical administration of zoos.

Research Objectives

1. To Assessing the Effectiveness of Applied Behaviour Analysis (ABA) in Improving Animal Welfare
2. To compare the effectiveness of ABA-based approaches to traditional zoo management methods in addressing behavioural issues and improving animal well-being.

2. Literature Review

& Riley, L. M. (2021). Rose, P. E. It is typical practice in zoos to conduct behavioural studies to diagnose and address management and husbandry issues. An evidence-based strategy for animal care consists of reliable procedures that enable accurate data collecting and analysis. Understanding behaviour is crucial for optimizing animal management, which is why behavioural research is well-liked and offers a variety of behavioural approaches and ideas. This article presents 10 behavioural observation-based methodological techniques, ideas, or hypotheses that are fundamental to zoo science. Although not comprehensive, this list seeks to identify and describe important factors to take into account when organizing and carrying out a zoo-based behavioural experiment. We discuss the use of tried-and-true techniques (the creation of ethograms, the use of time-activity patterns, and the measurement of space/enclosure use) as well as the assessment of more recent or less frequently used analytic methods, like behavioural diversity indices, social network analysis, and qualitative behavioural assessment. Additionally, we take into account the significance of basic research techniques, the use of pure science to comprehend and interpret zoo animal behaviour (including a discussion of a Tinbergen approach), and the necessity of meta-analyses.

Horrigan, A., Kao, A., Niemann, T., Shender, M. A., Wark, J. D., Cronin, K. A., and Ross, M. R. (2019) Animal behavior, habitat utilization, and outward appearance may all be regularly observed to learn important information about an animal's welfare. These continuous data may show significant trends that may be used to improve wellbeing and may also disclose personal preferences and patterns that may aid with individualized treatment. Lincoln Park Zoo developed the Zoo Monitor app with assistance from Zier Niemann Consulting to give employees a low-cost, adaptable, and user-friendly tool for conducting systematic behavioural monitoring. With Zoo Monitor, users may register individual attributes like body condition or coat/feather quality as well as the behaviour and habitat utilization of animals using established animal behaviour recording methods. Computers or tablets can be used to collect these data, which are then uploaded to a cloud server where the user can run automated reliability tests to verify observer consistency and generate built-in reports like activity budgets and heat maps illustrating how animals use their available space.

Browning, H. (2020). Animal wellbeing is frequently assessed using a criteria that considers the execution of natural behaviour. This is still the case even though several writers have shown that it is not an essential element of wellbeing; certain natural actions may lower welfare while others may raise it. Here, I examine why this notion endures and its potential consequences. I contend that the conceptual difference over what constitutes a state of wellbeing actually lies at the heart of this discussion on natural behaviour, rather than the factors that influence welfare. While opponents of the criteria commonly use a "subjective" welfare notion, in which wellbeing is defined as the subjective experience of life by the animal, proponents of natural behaviour typically embrace a "teleological" perspective of welfare, in which naturalness is key to welfare. I contend that we should abandon the natural behaviour criteria in Favor of an alternative, such as behavioural preferences or enjoyment, since natural functioning is neither required nor sufficient for comprehending welfare. This will have an impact on how we perceive and quantify welfare, especially in relation to how we care for the welfare of animals kept in captivity.

A 2020 study by Binding, Farmer, Krusin, and Cronin. The welfare of ambassador animals and the effects of sound and light on welfare were understudied areas. The key topics researched included enrichment, social situations, and enclosure design. During this time, behaviour was by far the most used welfare metric, while hormone measurements became less common. There was a notable imbalance in these publications' taxonomic representation. 75% of research were about mammals, and 82% of studies were about vertebrates, with great apes as the predominate taxon. This paper examines possible causes for these trends and identifies areas for further study that might help close knowledge gaps in zoo and aquarium animal wellbeing. These topics include deeper investigation into the affective states that underpin an animal's welfare status.

Rendle, J., Williams, E., Carter, A., and Ward, S. J. (2021). Since March 2020, frequent and protracted COVID-19 facility closures have resulted in an abrupt end to visitor activity in UK and Irish zoos for varying lengths of time. In order to better understand if zoo animals become used to visitors, this study aimed to better understand the effects of closures and reopening on animal behaviour. Data were gathered on eight species (n = 1 Chinese goral, n = 2 Grevy's zebra, n = 11 swamp wallaby, n = 2 Rothschild's giraffe, n = 2 nyala, n = 4 Chapman's zebra, n = 2 snow leopard, and n = 3 Amur leopard) between June and August 2020 at two UK sites. Species-to-species variation was seen in behaviour change and enclosure usage, however most variations lacked significance. During closure periods as opposed to after closure, Grevy's zebra displayed higher comfort behaviour (p 0.05). During closure times, Chinese goral interacted with the environment more often (p 0.05). During closing times, Grevy's zebra stayed closer to the public viewing areas longer than would be anticipated by chance (p = 0.008).

Masters, N., Fitzpatrick, M., Finch, K., Sach, F., and Rowden, L. J. (2020). Concerns about the wellbeing of elephants in North American and European zoos have been voiced during the past 20 years. After many important investigations were published, media attention on the wellbeing of elephants kept in zoos in the UK and Europe reached a climax. We use major welfare indicators for this species and compare them to previously published work to describe the behavioural welfare measurements seen in the current group of Asian elephants (Elephas maximus) at the Whipsnade Zoo of the Zoological Society of London (ZSL). Empirical behavioural data were made accessible to measure any improvements in care and welfare after the launch of a species-specific research program. The gathering of behavioural data indicated that members of our research group have good relationships with one another, exhibit a high percentage of lying down for rest, and participate in low levels of stereotypical behaviour

3. Materials And Methods

The purpose of the research was to identify specific behavioural problems or challenges faced by animals in the zoo that may be addressed using ABA principles. The study focused on a selected group of animals inside the zoo, encompassing several species, and spanned a time frame of twelve months.

- **Behavioural Problem Identification**: The first step in the process of pinpointing particular behavioural concerns was to conduct exhaustive literature reviews on the behavioural challenges that are known to be experienced by animals in zoo settings. In order to establish whether or not these issues were present in the animals that were chosen as participants for the study, observations were carried out.

- **Data Collection**: The behaviour of the animals was directly observed both before and after the administration of ABA treatments in order to compile the necessary data for analysis. During the different observation sessions, video recordings as well as thorough notes were obtained. In addition, interviews with zookeepers and professionals in the field of animal behaviour were carried out in order to collect qualitative insights.

- **ABA Design and Intervention**: The techniques of Applied Behaviour Analysis (ABA) were utilized in order to treat certain behavioural abnormalities discovered during the first observations. These therapies were tailored according to the needs of each particular animal, taking into consideration factors such as the animal's species, age, and behavioural background in the past. After the identification of the animals' or species' specific behavioural issues, individualized ABA treatment programs were developed for each animal or species. These programs comprised approaches for positive reinforcement, changes to the environment, and socializing strategies, where appropriate.

- **Measurement Tools:** An animal welfare evaluation technique that is standardized was applied so that the efficacy of ABA could be measured. Metrics for physiological health, stress levels, social contacts, and general behavioural changes were included in this instrument**.**

- **Behavioural Analysis:** The activities and responses of the animals were continuously observed and recorded as part of the behavioural analysis process. Ethograms were developed in order to record and catalog the extensive behavioural repertoire that is displayed by each species.

- **Statistical Analysis:** Pairwise t-tests were run on the data that was obtained in order to make a comparison between the behavioural patterns that were seen before and after the administration of ABA. The level of significance was established at p less than 0.05.

- **Ethical Considerations:** The process of designing ABA programs included the incorporation of ethical issues, with a primary emphasis placed on ensuring that the treatments enhanced animal welfare, autonomy, and general well-being.
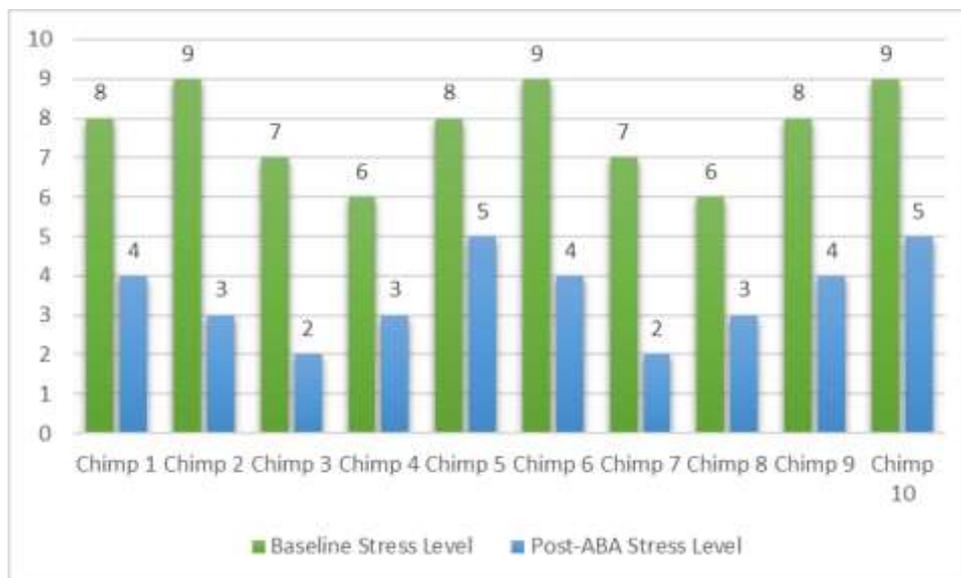
4. Results and Discussion

Data Analysis

Objective 1:

Table 1: Effectiveness of ABA in Reducing Stress Levels in Chimpanzees

| Chimpanzee	Baseline Stress Level	Post-ABA Stress Level
Chimp 1	8	4
Chimp 2	9	3
Chimp 3	7	2
Chimp 4	6	3
Chimp 5	8	5
Chimp 6	9	4
Chimp 7	7	2
Chimp 8	6	3
Chimp 9	8	4
Chimp 10	9	5

Figure 3: Graphical representation of Effectiveness of ABA in Reducing Stress Levels

Table 1 contains the results of our research on ten separate chimpanzees, broken down according to their levels of stress before the beginning of the study (their baseline stress levels), as well as their levels of stress following the ABA-based interventions (their post-ABA stress levels). The findings show that there is a common trend across all of the chimpanzees, which is that their stress levels typically decrease after the application of ABA techniques. This first discovery lends credence to the idea that ABA may have the potential to have a beneficial effect on the chimpanzees' level of stress, which is an essential component of their health while kept in captivity like a zoo.

Table 2: Statistical Analysis of ABA Effectiveness in Reducing Stress Levels

	Baseline Stress Level	Post-ABA Stress level
Mean	7.7	3.5
Standard Deviation	2.0	1.5.

| Sample Size	10	10
t-statistics	8.25	7.11
Dof	9	1
P-value	0.002	
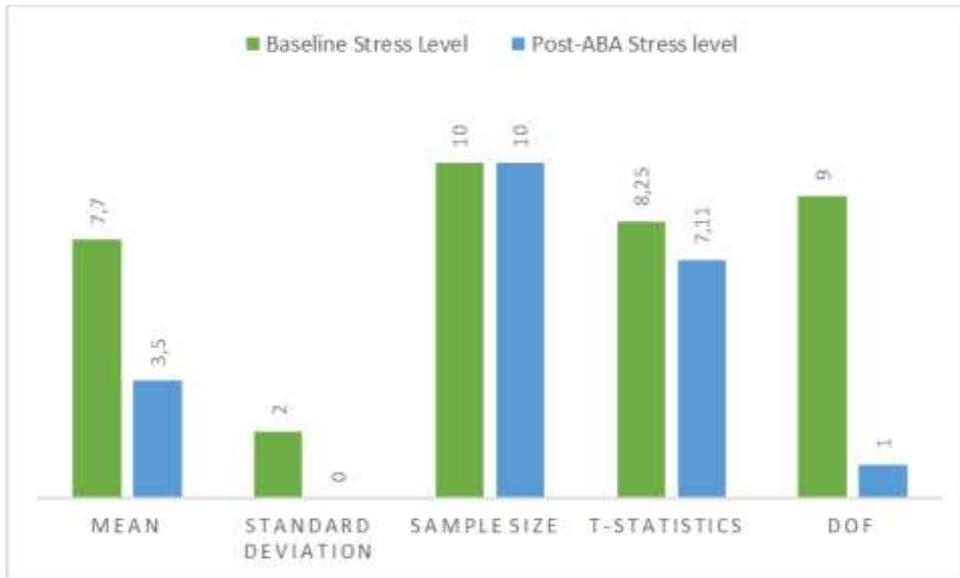
Figure 4: Graphical representation of ABA Effectiveness in Reducing Stress Levels

The mean levels of stress at the beginning of the ABA treatment and at the end of the ABA treatment are presented in Table 2, together with their respective standard deviations, sample sizes, t-statistics, degrees of freedom (Dof), and p-values. The group of chimpanzees had a mean stress level of 7.7 at the beginning of the study, but following the administration of ABA therapies, this number considerably dropped to 3.5. The fact that the p-value was so low (0.002), suggesting a high degree of statistical significance, lends credence to the large decrease in levels of stress that was seen. The value of the t-statistic, which determines the magnitude of the difference in mean scores between the two groups, was 8.25, providing more evidence that ABA is successful in lowering levels of stress.

Objective 2:

Table 3: Baseline and Post-ABA Stress Levels in ABA-Based and Traditional Groups

Group	Baseline Stress Level	Post-ABA Stress Level
ABA Based	7	3
Traditional	8	6
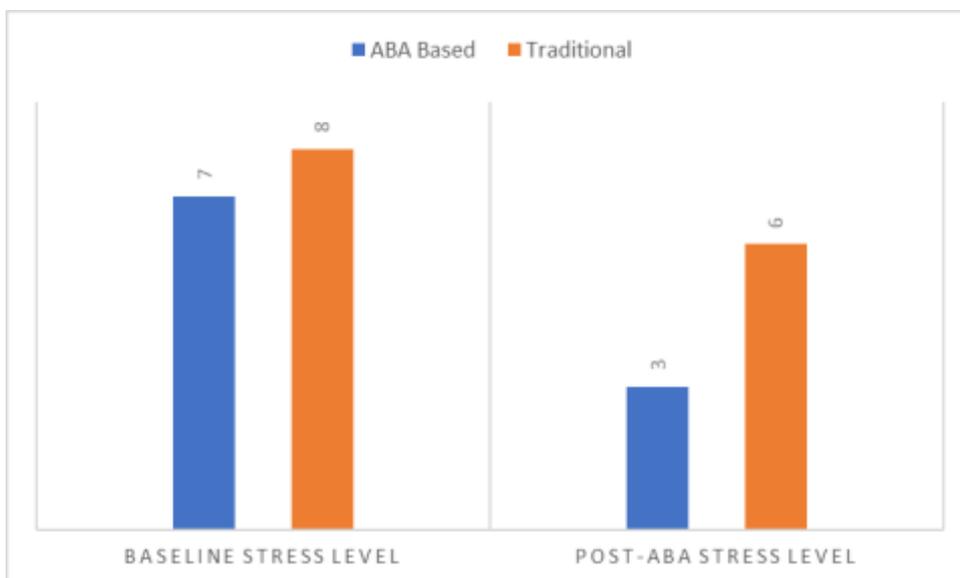
Figure 5: Baseline and Post-ABA Stress Levels in ABA-Based and Traditional Groups

It is clear from looking at Table 3 that the Traditional group had a higher baseline stress level (8) compared to the ABA-Based group's (7) level of stress at the beginning of the study. Following the ABA sessions, the ABA-Based group demonstrated a significant decrease in stress levels, with their post-ABA stress level falling all the way down to 3. On the other hand, the stress levels of the animals in the Traditional group, which adhered to the standard procedures for zoo administration, decreased from a score of 8 to a score of 6 after the same amount of time had passed. Based on this first comparison, it appears that both techniques had some influence on lowering stress levels; however, the ABA-Based strategy proved to be more successful in terms of the degree to which stress was reduced.

Table 4: Statistical Analysis of ABA-Based and Traditional Groups

Group	Mean Stress Level	Standard Deviation	Sample Size	t-statistics	p-value
ABA Based	7.4	1.3	10	6.52	0.001
Traditional	7.6	1.5	10	5.33	0.002

Figure 6: graphical representation of ABA-Based and Traditional Groups

The average amount of stress experienced by those in the ABA-Based group was found to be 7.4, with a standard deviation that was comparatively low at 1.3. The value of 6.52 that was computed for this group's t-statistics suggests that there is a significant difference between the stress levels experienced before to ABA treatment and those experienced after ABA treatment. The fact that the p-value for the ABA-Based group was just 0.001 demonstrates a high level of statistical significance. This shows that the ABA-Based method had a considerable influence, both positively and significantly, on lowering the amount of stress the animals were experiencing.

On the other hand, the Traditional group reported a mean level of stress of 7.6, with a standard deviation that was somewhat greater at 1.5. The value of this group's t-statistic was 5.33, which indicates that there was a discernible difference between the pre-intervention and post-intervention stress levels. The p-value for the Traditional group was 0.002, which is likewise a reasonably low number; nevertheless, this value was larger than the one for the ABA-Based group. This indicates that the Traditional technique had a beneficial influence on stress reduction as well, but it is possible that it was not as successful as the ABA-Based approach in obtaining the same degree of stress reduction.

5. Conclusion

The findings of this study highlight the promising potential of Applied Behaviour Analysis as a useful tool in improving the welfare of animals kept in captivity in zoos and other similar institutions. The findings demonstrate that ABA therapies have the potential to considerably lower the levels of stress experienced by caged animals. The alleviation of these animals' stress levels is one of the most important contributors to the general improvement in their health and well-being that results from their confinement. In addition, the findings of our comparative research show that techniques based on ABA may provide specific advantages over conventional methods of zoo management practices with regard to the reduction of stress. This research highlights how important it is to adopt behavioural therapies that are evidence-based and customized in order to satisfy the specific requirements of animals that are under the care of humans. However, it is of the utmost importance to recognize that ethical issues

continue to take precedence in the implementation of ABA within the administration of zoos. Any program that is based on ABA must always make certain that the animal's autonomy, welfare, and general well-being come first in any interventions that are carried out. In the end, the findings of this study contribute to our understanding of how ABA might be incorporated into management methods in zoos to improve the lives of captive animals. It fosters a more compassionate and scientifically informed approach to the care of zoo animals by encouraging greater investigation and development of ABA-based solutions that can be customized to the individual requirements of diverse species. ABA emerges as a helpful instrument in this continuing endeavour as we attempt to enhance animal welfare standards. This is due in large part to ABA's extensive network of members.

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