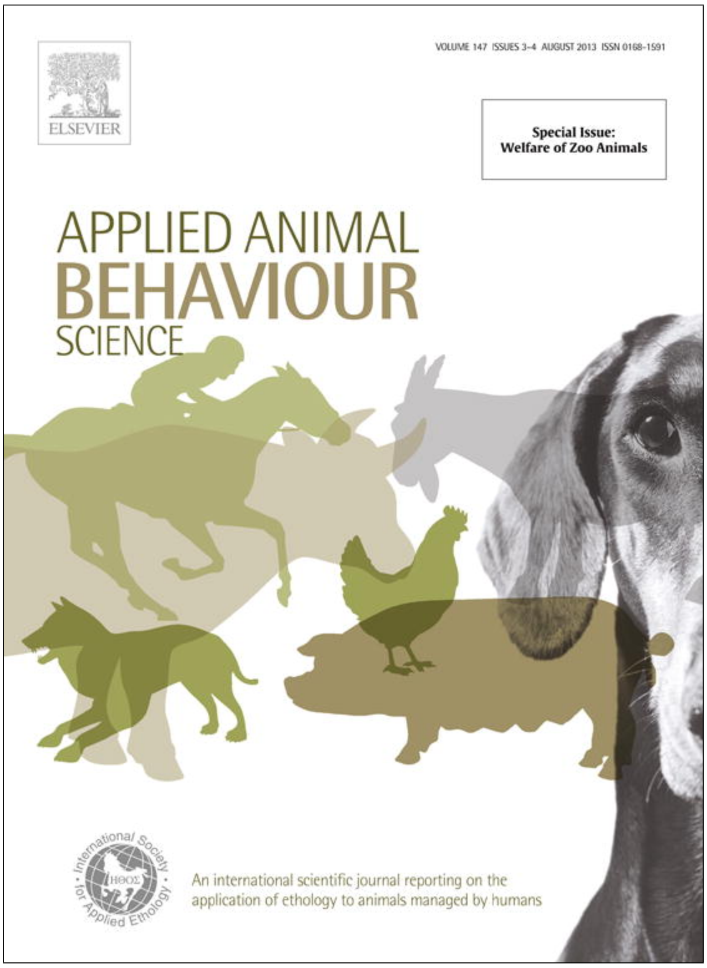
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Is training zoo animals enriching?

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ABSTRACT

Husbandry training of zoo animals (training) has been associated with many benefits, and indisputably is a valuable tool; training facilitates movement of animals within their environment, and participation in husbandry and medical procedures. Training has also been considered to be enriching. With few exceptions systematic empirical data have not been collected which have evaluated the impact of training zoo animals outside of the training session. Most publications in this area are methodological, outlining what behaviours can be trained and how, or consider the value of training whether it is believed to be beneficial or detrimental. Determining whether training is enriching, is in part hindered by semantics; what is meant by the suggestion that training is enriching? To move this situation forward five hypotheses have been suggested in this paper whereby animals would be considered to be enriched, if training: 1) affords learning opportunities, as learning is considered to be enriching; 2) can achieve the same results as conventional environmental enrichment (CEE); 3) increases human–animal interactions; 4) provides a dynamic change in the animals' day; and 5) facilitates the provision of CEE. These suggested hypotheses are by no means exhaustive, but represent commonly held assumptions used to explain how training might be considered enriching. These hypotheses provide a starting point to systematically consider available data which support or refute whether training is enriching; an evidence based approach.

Data collated revealed that training could be considered enriching according to: hypothesis 1, whilst the animal is still learning; hypothesis 2, if the ultimate consequence of training was considered itself enriching. More data are required to test hypothesis 3. And data did not support that training was enriching in and of itself according to hypotheses 4 and 5. In conclusion, training was not considered to be an appropriate alternative to the provision of CEE. Both, training and CEE are recommended to ensure an integrated holistic captive animal management strategy which will meet an animal's needs.

1. Introduction

Behavioural husbandry is a term used to describe the provision of environmental enrichment (EE) and goal orientated training of zoo animals (training). The provision of EE is almost ubiquitous in many zoos worldwide, and has been studied in zoos with exotic animals, but also in other animal industries with domestic animals e.g. agriculture, laboratory and companion (De Azevedo et al., 2007). Consequently, a lot is known about the underlying theory, practical implementation and consequences of EE which has been documented and systematically studied in the past few decades (Chamove, 1989; Hoy et al., 2010; Mellen and Sevenich MacPhee, 2001). In contrast, the incorporation of training, to facilitate husbandry and veterinary needs, has increased rapidly in the past decade, but few studies exist which have systematically evaluated the impact of this training on behaviour and welfare in zoo animals either at the time of training or outside training sessions (an exception is Pomerantz and Terkel,

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2009). There are however, some studies which have been undertaken on this topic with laboratory housed animals, notably primates (e.g. a special issue on this topic was edited by Prescott and Buchanan-Smith, 2003).

The uptake of training in zoos appears to have paralleled an increasing awareness and adoption of positive reinforcement training; providing a reinforcer the animal wants, to increase the likelihood of a target behaviour being performed in the future, e.g. offering food after the expression of a desirable behaviour (e.g. Grandin et al., 1995). In some circumstances, more frequently when people work free contact (without any barriers between themselves and the animals they are working with), negative reinforcement training is also used; providing a reinforcer the animal avoids, to increase the likelihood of a target behaviour being performed in the future, e.g. training an elephant to avoid an ankus. The use of negative reinforcement training has been well documented in horse riding, where it forms the most frequent and traditional basis of training, e.g. the application of pressure via reins, whip or human heels to change the horse's movement (Innes and McBride, 2008; McLean, 2005; Warren-Smith and McGreevy, 2007). Most training programmes, in zoos and elsewhere, will also incorporate punishment, the application of which decreases the likelihood that a behaviour will be performed in the future, e.g. during a 'time-out' an animal's attempts to gain human attention are ignored/punished (Roberts et al., 1988). Though the frequency of positive and negative reinforcement and punishment events are likely to vary in different zoo training programmes, most will include all three. The distinction between these types of training is important, because their implementation may compromise welfare rather than promote it; this is not readily discussed with reference to zoo animals, but consideration of these different techniques has been reviewed when training domestic dogs and horses (respectively, Hiby et al., 2004; McGreevy and McLean, 2009).

Promulgation of information about zoo animal training has mostly been achieved through oral presentations at conferences and workshops, and publications in the grey literature or books (McGreevy and Boakes, 2007; Ramirez, 1999). Some exceptions exist, where systematic empirical studies have been published in peer reviewed journals, which describe: successful training attempts, where the target behaviour (goal of training) can reliably be elicited on cue (Nyala *Tragelaphus angasi*, Grandin et al., 2005); different species which can be trained (Aldabra tortoises *Geochelone gigantea*, Weiss and Wilson, 2003; new world primates Savastano et al., 2003); and methodology of how to implement training (e.g. Colahan and Breder, 2003). Without a systematic empirical approach it is difficult to fully appreciate the costs or benefits associated with training zoo animals. Furthermore, without appropriate evidence the incorporation of training into zoo animal husbandry is based on anecdote, or assumption. It has been suggested previously that zoo animal management decisions need to be evidence based (Melfi, 2009), following on from the incorporation of evidence based frameworks in other disciplines, namely conservation (Sutherland et al., 2004). In brief, evidence based frameworks propose that all interventions (i.e. zoo animal management decisions) should occur as a result of consulting what evidence exists. The reliability, and thus value of this evidence, varies along a continuum from myth/tradition to peer-reviewed information.

When zoo animal training appears in both grey and peer-reviewed literature, authors often infer that training enriches the participating animals. To date, no study has been published which has collected or analysed data to test this *a priori* hypothesis. There are, however, a variety of established methods which have been used to determine whether an object provided or strategy adopted effectively enriches (e.g. Plowman, online); Young (2003) suggests that objects provided or strategies adopted should not be considered enrichment, instead putative enrichment, until data exist to demonstrate they have been successful. Furthermore, enrichment evaluation has become integral to the management and delivery of enrichment programmes, and it has been proposed a similar model be used to manage training in zoos (e.g. SPIDER, the acronym given to the process which includes setting goals, planning, implementing, documenting, evaluating and readjusting, Colahan and Breder, 2003; a SPIDER like process is a requirement of Association of Zoos and Aquariums enrichment and training programmes). As a consequence empirical data exist which demonstrate the efficacy of a variety of enrichments which lead to significant positive changes in behaviour and welfare benefits of zoo animals, e.g. ameliorating stereotypies (Mason et al., 2007; Swaisgood and Shepherdson, 2006), enhancing reproduction (Carlstead and Shepherdson, 2005), and alleviating stress (Carlstead and Shepherdson, 2000); these will be collectively referred to as conventional environmental enrichment (CEE). It seems reasonable to suggest a similar approach be taken to address whether training is enriching.

2. Testing hypotheses

To enable an evidence based approach be adopted and provide a better understanding of whether training can be considered to be enriching to zoo animals, available published data will be used here to test the following hypotheses; these hypotheses are not exhaustive, but encapsulate the most often argued assumptions which support that training is enriching.

Training is enriching because it:

a) affords learning opportunities, and learning is considered to be enriching;
b) can achieve the same results as CEE;
c) increases human–animal interactions;
d) provides a dynamic change in the animals' day;
e) facilitates the provision of CEE.

2.1. *Training is enriching because it affords learning opportunities, and learning is considered to be enriching*

A large number of people consider training to be enriching as it affords learning opportunities. Learning is defined as a change in behaviour resulting from practice or experience, and when this is dictated by humans it has been termed training (Mellen and Ellis, 1996). Studies have established that active learning in animals is associated with many beneficial ramifications, for example improved brain form, function and development (e.g. van Praag et al., 2000) and increased ability to cope within the environment (discussed by Carlstead, 1996).

Furthermore, it has been demonstrated that many captive animals actively seek out learning opportunities, a phenomenon termed contrafreeloading (Osborne, 1977). The ultimate advantage to contrafreeloading is still being explored and debated (Inglis et al., 1997). In studies where the same resource is presented in a 'hard to get to' and 'free' form, many captive animals choose to work for a resource, in preference to choosing the same resource which is freely available. For example, when maned wolves (*Chrysocyon brachyurus*) were provided with food, via two different methods simultaneously, they preferentially chose 'hard to get to' food (scattered around their enclosure) versus food on a tray (free) (Vasconcellos et al., 2012). Similar findings are also observed in many zoos, when food is provided both in enrichment devices (which require work to gain the food) and in food dishes (free food) simultaneously, and the animals opt to use the enrichment device as a source of food (e.g. Clark and Melfi, 2011; Li et al., 2009; McGowan et al., 2010).

There seems little doubt that learning is associated with many benefits, but it is important to consider that the end goal of training is an animal which has learnt to perform a behaviour on cue. Once the animal can perform a behaviour on cue, it is no longer an active learner. The successful completion of a learning task is usually monitored by observing how often an animal reliably performs the behaviour on cue, and when this can be achieved significantly more often than accounted for by chance alone, the animal is considered to have learnt the behaviour (e.g. Schapiro et al., 2003). With each repetition the trained behaviour becomes more fixed, and more reminiscent of a reflex.

For the many trained animals in zoos, which are extremely reliable in performing the appropriate behaviour on cue, training no longer represents a learning opportunity. As such, once a behaviour is learnt, it seems unlikely that the performance of that behaviour is in and of itself enriching (see below, hypothesis 2).

Interestingly, CEE developed from a practice devised by Hal Markowitz, which he termed behavioural engineering. The aim of behavioural engineering was to stimulate species-specific behaviours in zoos animals (Markowitz, 1982). The scenarios provided animals with the opportunity to perform a behaviour, for which they were then reinforced; thus operant conditioning techniques were the primary tool for increasing the animals' species-specific behaviours. For example, a computer-controlled acoustic prey device played bird noises which, when an African leopard actively pursued it, would then release small quantities of food (Markowitz et al., 1995). Markowitz and his colleagues reported many benefits of behavioural engineering, for example improved health and physical fitness through physical activity (e.g. Markowitz et al., 1978). There were criticisms of this practice, because the basis that animals might work for a reward was considered anthropomorphic (e.g. Hutchins et al., 1978); as many animals contrafreeload this concern was probably unfounded. However, circumstances did also arise where animals performed the target behaviours at extremely high levels. It was also considered undesirable that there was no contingency between the stimuli and the reward (explored further in hypothesis 2 below). A proposed alternative was generally favoured, where animals were provided with opportunities within their environment, through the provision of complex environments (environmental enrichment) rather than as a consequence of an operant task (Hutchins et al., 1978). Later it was recognised that both techniques, behavioural engineering and environmental enrichment, had value and it was suggested they be integrated into husbandry practice (Forthman Quick, 1984).

Animals are sometimes trained to use CEE, by reinforcing behaviours directed towards the CEE, or through a process of 'shaping' trained how to use the CEE. The process of 'shaping' breaks down the end goal behaviour (use of the CEE) into successive steps or approximations which are reinforced over a series of training sessions until the end goal behaviour is achieved (Pryor, 2002). As such, CEE use is established through operant conditioning (training). When animals are not actively trained to use CEE, use is determined by other factors, including trial and error learning (left to their own devices). Trial and error learning is likely to offer animals different opportunities for learning, when compared to focussed operant conditioning, which has been tailored to teach a behaviour as rapidly and effectively as possible. These different learning opportunities are expanded upon below (hypothesis b), where CEE use and training are seen to be procedurally similar but functionally different on four dimensions.

In summary, whilst an animal is being trained to perform a behaviour it seems reasonable to suggest that associated benefits gained through learning represent an enriching event. However, training is no longer considered to be enriching once a behaviour is learnt. It is also recognised that training an animal to use CEE is likely to reduce the animals' potential for learning, as it is contingent on directed learning.

2.2. Training is enriching because it can achieve the same results as effective 'conventional environmental enrichment' (CEE).

A view held by many is that training should be considered enriching as it can achieve the same results as CEE. These results can be viewed in terms of their ultimate and proximate functional outcomes, i.e. can training result in indicators associated with effective CEE, and/or is the process of training and CEE use similar?

As the provision and study of CEE in zoos has developed, so too has the definition of what constitutes enrichment (Melfi, 2009); which informs what indicators are used to determine whether CEE has been successful. Initially, CEE was provided to make a positive change to animal behaviour. For example, initially CEE was expected to increase species specific behaviours, or behavioural diversity, flexibility and exploration, or reduce the disparity between wild and captive animal behavioural repertories, or stereotypies and other abnormal behaviours (e.g.

Hunter et al., 2002; Moreira et al., 2007; van Hoek and King, 1997). It was soon established that implementation of CEE also had significant impacts on non-behavioural parameters and improved biological function. For example, CEE use was associated with improved reproduction and physical fitness, brain development, recovery after surgery (trauma), as well as reducing health problems (e.g. Barnard et al., 1996; Healy and Tovee, 1999). These associated behavioural and physiological measures are not exhaustive but provide an overview of the diverse measures used to assess CEE efficacy. As enrichment as a concept has evolved, it would seem that many practitioners consider any change to captive housing and husbandry conditions which improve animal welfare to be CEE; this is discussed further in hypothesis 4.

Training can be used to successfully achieve behaviours associated with effective CEE use, and to facilitate veterinary checks and other management requirements which are likely to result in improved biological function (Young and Cipreste, 2004). Both of these factors are likely to increase animal welfare; a cost-benefit analysis is probably necessary to determine the full welfare implications of training, which is outside the scope of this paper. Unfortunately, few data exist which have set out to explore the impact of training, beyond the ability to train target behaviours, on the behaviour and biology of zoo animals. On the evidence which exists, the ultimate outcomes of both training and CEE look the same, with some exceptions. Behavioural change which occurs as a result of training, unlike CEE, does not usually generalise outside the training session, as it usually only occurs when the appropriate cue is present. Cues are usually only provided during relatively short training sessions, though behavioural engineering devices can provide repeated cuing of behaviours. Melfi and Thomas (2005) demonstrated the incorporation of a training programme had little effect on the behaviour of zoo housed colobus monkeys *Colobus guereza* outside the training session; activity budgets, social behaviour, proximity between individuals and enclosure did not change. Human directed behaviours did change, and decreased steadily as the training programme progressed, suggesting the human–animal relationship was modified as a consequence of training (discussed further in hypothesis 3).

An innovative paper by Hare and Sevenich (2001) explored the process involved in training and CEE use, and provided an insight into the proximate function of these two strategies. They used the example of a tiger which was required to scratch the bark of a tree. In the first strategy a novel scent was sprayed in the tiger's enclosure (CEE), while the second strategy used positive reinforcement training techniques to elicit the behaviour. Four steps are shared by these two strategies: provision of a stimulus which triggered the behavioural response (Cue, ring of a bell vs scent in the enclosure); the latency between the tiger's behavioural response and the provision of reinforcement (Window of opportunity, a pre-set time usually less than a minute vs as long as the smell lasted in the environment); the type of behaviour resulting from the stimulus (Behaviour, a stereotyped movement of the right paw in a downward motion on a tree vs diversity in duration, timing and type including sniffing, scent marking, rolling, rubbing and scratching); and the relationship between with stimulus and behavioural response (Contingency, an artificial stimulus followed by an artificial behaviour, extrinsic reinforcement vs a biologically relevant stimulus followed by a species specific behaviour, intrinsic reinforcement). The framework suggested by Hare and Sevenich (2001) demonstrated clear similarities in the steps required to stimulate behaviour mediated by training or CEE. It was clear however, from the example suggested, that there were many qualitative differences between these two strategies. The training scenario provided less flexibility, control and an artificial contingency between cue and behaviour, compared to the CEE strategy which utilised a naturally occurring contingency between cue and stimulus and resulted in a tiger which performed many different scent-marking behaviours over a protracted period of time.

Finally, it has been suggested that a training session could be incorporated into a CEE programme or leave CEE redundant entirely; as training is enriching. Few studies have directly compared the behavioural consequences of CEE and a training session in achieving the same goals; often goals of CEE are determined by evaluating changes in animals' activity budgets. A study conducted by McCormick and Melfi (2003) aimed to increase behavioural diversity in two zoo housed elephants; a common goal for CEE studies. The study provided CEE (a log covered in seeds and nuts) and a husbandry training session (30 min of positive reinforcement training) in different combinations daily; thus enabling the impact of an enrichment and a training session to be directly compared. Data collected found that training had no significant impact on the activity budget of either elephant, but CEE did significantly increase behavioural diversity in one of the elephants.

In summary, training can indeed be used to achieve the same outcomes as the provision of CEE, however the expression of these outcomes are unlikely to be of themselves enriching; though their consequences may improve animal welfare. Furthermore, there are qualitative differences in the process by which training and CEE achieve behavioural change, which further support rejection of the current hypothesis that training be considered enriching.

2.3. *Training is enriching because it increases human–animal interactions*

Training zoo animals provides an opportunity for keepers to engage in sometimes prolonged human–animal interactions (HAI) beyond those encountered during routine husbandry. Keepers represent one of two main groups of people who actively engage with zoo animals, the other group are zoo visitors; the term keeper here refers to zoo professionals generally. Humans in the zoo environment have also been grouped according to whether they are familiar (keepers/zoo professionals) or unfamiliar (visitors) to the zoo animals (Hosey, 2008). The type, duration and frequency of HAI experienced by zoo animals has not been reviewed, but varies considerably, from those animals which experience little or no human contact (e.g. free ranging animals or those managed in extensive paddocks), versus animals which are part of education programmes, whose primary role is to interact with visitors.

Implicit in the hypothesis that training is enriching because it increases HAI, is the assumption that these interactions are enriching to zoo animals. Hosey (2008) described three different human–animal relationships (HAR) which could result from HAI; positive, neutral and negative. He went further to suggest that where there were positive HAI which develop into positive HAR, animals may perceive humans to be enriching. A review of this topic by Claxton (2011) concluded that there were some elements of zoo HAI which might be considered to be enriching. Unfortunately there are no data which have directly explored whether humans are enriching in a zoo context. But there is an intuitive appeal for some that the presence and interactions of humans with zoo animals is enriching, especially as humans are a constant component of every zoo animal's life (Hosey, 2005).

HAI which occur during training sessions can be set apart from those which occur during other contexts. Successful training is founded on effective bidirectional communication so that both human and animal achieve their goal; training the target behaviour, and gaining the reward, respectively. Whereas, many other HAI are not dependent on bidirectional communication, but are initiated by either party with a variety of motivations and consequences. For example, zoo visitors, for which the greatest body of literature exists on zoo HAI (reviewed by Hosey, 2000), are likely to be largely ignorant to the animals' communication cues and yet initiate interactions with them regardless. Broadly, these human (visitor) initiated interactions towards zoo animals appear to have a negative impact on primate species and little visible impact on felids (see Hosey, in press). By contrast, the effective communication resulting from successful training sessions may provide opportunities where both parties (human and animal) are able to learn about each other. It is unclear how increased effective communication may enrich the lives of zoo animals *per se*, but it certainly does have the potential to lead to positive HAI, HAR and potentially human-animal bonds if conducted appropriately (Hosey and Melfi, 2012).

2.4. *Training is a dynamic change in the animals' day, and therefore equates to the provision of EE.*

Certainly training does provide a dynamic change in animals' lives, but whether this alone makes it enriching is unlikely. Change in and of itself is not necessarily good. For example, other changes in the animals' day may include, change in weather, catching the animal up, or being stung by a wasp, all of which make added variation to the animals' day, but none of these would be considered enriching. An extreme example was heard by the author at an international conference, where it was suggested that stomach tubing an animal would be enriching, because it offered some change to the animal's day. There are many facets to animals' daily routines which could be measured with respect to their impact on animal welfare, but the most likely components are whether the events were predictable or not. Few studies have examined the effect of predictability (in husbandry routines) on zoo animal welfare, but published data are mixed in their conclusion about whether zoo animal welfare is better with predictability or unpredictability (Hosey et al., 2009).

2.5. *Training facilitates the use of conventional environmental enrichment*

Finally, some consider training to be enriching because it facilitates the provision of CEE. Many zoo animals are managed under protected contact, where animals and keepers are kept separate by barriers and expected to occupy different spaces. CEE provision which requires keepers to enter the animals' space (to provide, refill or remove CEE) necessitates that the animal is moved to other areas of their enclosure. With a training programme, the animal can be efficiently and successfully moved on cue, allowing the provision of CEE use to be facilitated. As such, this hypothesis is supported as there is evidence that many species, including mammals, birds and reptiles can be trained to move within their enclosure readily and reliably on cue (e.g. reviewed by Young and Cipreste, 2004).

3. Conclusions

There is value in considering whether training zoo animals is enriching, from both a theoretical and practical perspective. Equally it is important that zoos adopt an evidence based approach to housing and husbandry; as such it is important to understand the implications of making changes to the animals' lives. Training zoo animals is for some species essential, for others to be avoided. However, few studies have been undertaken to explore the impact it may have on animals; instead untested statements prevail, as per the title of this paper 'is training zoo animals enriching'.

In this paper, five hypotheses were proposed which best capture how training enthusiasts consider training to be enriching. Data have been collated to test these hypotheses, but it is obvious further research is needed in this area. Of the five hypotheses suggested, there was greatest support that training be considered enriching because it affords learning opportunities for zoo animals. Though it was noted that once an animal had learnt a behaviour, participation in training *per se* was unlikely to be enriching and there was little support for the other four proposed hypotheses. There is scope that HAI may be enriching, for some species, as there is an element of learning required. There may also be other enriching qualities inherent in HAI, but truly more data are needed.

In summary, training is a husbandry technique, the implementation of which is increasing steadily and so it is imperative that its implications on zoo animal behaviour and biology are understood. The extent to which training is enriching, is but one consideration in its implementation. There are other benefits and concerns associated with training, which need to be considered in cost-benefit analyses to determine whether it should be implemented on a case-by-case basis, regardless of whether it is considered enriching.

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