

## Auditory and Cognitive Enrichment Training for a Male Asian Elephant

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**Abstract.** This paper describes a behavioural enrichment project for a male Asian elephant (*Elephas maximus*) at Perth Zoo, that utilizes the elephant's auditory abilities. The project provided cognitive challenges for the elephant, as well as extending his use of listening discrimination and investigation of his environment.

### Introduction

Research reviews of elephants' auditory capacity have focussed not only on the range of frequencies used in elephant vocalizations and communication (Payne *et al.* 1986; Poole *et al.* 1988), but also on their auditory discrimination capacity and links with their vocalization, social communication and behaviour (Soltis *et al.* 2009; Soltis 2010, 2011; Soltis *et al.* 2014). These studies have described the way in which the hearing by elephants of different human and animal sounds result in different vocalizations and behaviour by them (Soltis *et al.* 2014). Studies have also reported the vocal imitation by captive elephants of human speech sounds and machine sounds (Stoeger *et al.* 2012; Stoeger & Manger 2014). Other research has investigated auditory stimulation in the form of classical music for zoo-housed elephants, and suggests a decrease in stereotypical behaviour as a result (Wells & Irwin 2008).

Bates *et al.* (2008) note that research conducted in 'more ecologically valid ways' suggests that elephants have excellent auditory discrimination, along with aspects such as extensive memory, ability to distinguish between different human ethnic groups, and ability to monitor and remember the locations of elephant kin. The review by Plotnik *et al.* (2009) argues that 'collaborative cognitive research efforts' by scientists and zoo staff can result in research that benefits the health of the elephants and leads to scientific advances in knowledge. However, researchers note that we are only in the early

stages of our understanding of the neural basis of elephant's auditory and vocalization systems.

This paper describes a behavioural enrichment project with a male Asian elephant (*Elephas maximus*) at Perth Zoo, Australia, which was aimed at increasing opportunities within enrichment training projects for the utilization of the elephant's natural sensory and cognitive abilities. It utilizes the elephant's auditory discrimination capacity to provide cognitive stimulation and problem solving situations as well as increased opportunities for physical exercise and investigation of his environment. The paper provides detailed descriptions of the project in order to share this information and to provide assistance for others in trialling this behavioural enrichment project.

### Methods

#### *Details of the elephant*

The male Asian elephant Putra Mas is 28 years of age. He was born in the wild in approximately 1989 and came to Perth Zoo from Malaysia with two female elephants of similar age in 1992. He was originally housed with the female elephants and handled in free contact until 1999. He was then moved to an adjacent enclosure in open protected contact when he reached sexual maturity. The auditory discrimination training project was commenced with Putra Mas in 2015.

#### *Details of the keeper*

The Technical Officer Zoology (who is referred to in this paper as the ‘keeper’) is female and has worked at Perth Zoo in the elephant section for eight years. Previously, her work has been with marine mammals for 19 years, and she has been involved in behavioural enrichment training projects and observation research projects.

### Description of training stages

When the author began working with Putra Mas, she was very impressed with his capacity to learn and his ability to discriminate between different behaviours. For a keeper, there is a responsibility to think of new and interesting challenges that let the elephant test his own natural abilities and also provide the physical and mental exercise important for his wellbeing. These behaviours would be ones that would be physically and mentally challenging but also follow a natural behaviour line. As well as using the sense of smell for enrichment training (Holland 2018), the keeper decided to see if Putra Mas could distinguish and respond to voice verbal cues given over the two-way radio. A description of the development of the project is provided here. The keeper can be contacted for more detailed information on the training stages.

#### *The initiation of the project in 2015*

The initiation of the project was aimed at extending the elephant’s auditory and cognitive stimulation through the challenge presented in associating and responding to the keeper’s voice delivered via the two-way radio, without her



**Figure 1.** Putra Mas responding to a challenge given through the radio placed near the enclosure.

physical presence (Fig. 1). This training concept presented a new test of his listening and cognitive capacities. The project was also particularly focussed around behaviours associated with long distance recalls for extending the physical exercise of the elephant. ‘Recall’ in this context is defined as the process of sending or retrieving an animal from one point of station to another through the use of a conditioned stimulus (IMATA 2004).

#### *The pairing of keeper with radio, and approximation of keeper out of elephant’s visual sight*

The project began in July 2015, with the keeper pairing herself with a radio which was on the ground in front of Putra Mas. Initially, the keeper was visible to the elephant as she gave an auditory cue through a hand-held radio for a vocal behaviour by the elephant. At the next training session, the keeper approximated herself out of the elephant’s sight in two stages and gave the same auditory cue over the radio. Again, the elephant responded with the appropriate vocal behaviour, despite the keeper not being physically present or visible to him. In the third training session with Putra Mas holding a steady position in his barn, the keeper approximated herself out of his sight and to his off-display area. The keeper then asked Putra Mas (via the radio in the barn) to move forward. She also added a recall sound (a previously learnt skill) after the verbal cue. This introduced the radio recall concept into the training. In this session, Putra Mas was successful in the radio recall from the barn to bath area and back (65 m each way) and from the barn to the pool area and back (75 m each way).

With the recall sound being paired with the ‘Move Up’ or (forward) verbal cue, the recall became an associated behaviour. Once the recall behaviour became an established behaviour using the application of reinforcement – food, intermediate bridge (whistle), verbal praise and encouragement, and verbal bridge, the visual indicator of the radio could be removed. This concept is known as ‘radio recall’. Putra Mas quickly learnt the concept of moving forward via the radio recall. Since then, new concepts

and challenges have been introduced by using additional radios in the exhibit in order to direct him for additional travelling behaviours.

The beauty of the recall is that it can be introduced as a directional cue for a particular training session and thus provides flexibility for the keeper changing position when desired, so that the keeper locations can be easily changed to provide variation in direction patterns and cognitive stimulation for Putra Mas. Usually, Putra Mas will need only one introductory recall sound to establish the direction desired for the training session. This means that Putra Mas acknowledges the desired destination.

### *Extending the project*

In the first training session, the initial verbal cue requested one vocal behaviour from the elephant. In following sessions, the keeper introduced and requested other behaviours (ones which were already well established behaviours for the elephant) via the medium of the radio. In addition, the project was extended by adding more location points for the elephant to travel to, and by extending the distance travelled. The elephant was responding well to the cue and recall sound, moving from the barn to a number of possible locations where the recall sound was being produced. In the daily notes, the keeper recorded good motivation and fast walking pace on the part of the elephant. By March 2016, the project involved radio recalls from the barn to the furthestmost part of the exhibit area.

### *Additional extensions to the enrichment project*

Later on, CCTV was utilized to observe Putra Mas's responses from the staff office. After only a few training sessions, the keeper was able to remain inside the staff office (Fig. 2) directing Putra Mas via the radio and observing his responses, since he had learnt to be able to extend the length of waiting time between the verbal cue and the delivery of food reinforcement by the keeper. What impressed the keeper most was Putra Mas's ability to accept and follow instructions via the radio through to the successful completion of the requested behaviours.

The project was also extended by the addition of a second keeper who added extra behaviours to the project. In late May 2016, she introduced a new location idea into the training, whereby an additional radio was positioned at the hydraulic control system (40 m from the barn), and placed on the ground without a keeper needing to be present with it. For the first training session to introduce this remote radio location, the radio was paired with the keeper's voice at the location. This was then followed by the visual removal of the keeper. This provided an extension of the original radio recall.

### *Remote radio directional travel*

By November 2016, Putra Mas was using all of his exhibit area in the remote radio directional travelling behaviours. This process continues with the elephant showing enthusiasm for behaviours requested, and getting good physical exercise and mental stimulation in the process of the enrichment training.

The original radio recall training concept of moving from one location to another, when combined with an intermediate bridge (a whistle) at the same time, supplied directional information to the elephant and provided a platform to introduce the new training concept, i.e. of remote radio directional travel. The intermediate bridge confirms to the elephant that he is moving in the required direction and to continue in that direction. Removal of the recall sound combined with the intermediate bridge (the whistle) presented the elephant with the new concept of remote radio directional travel.



**Figure 2.** Directing Putra Mas from the office.

By May 2017, the original behaviour of ‘moving up’ on request from the barn to the top of the exhibit, had been learnt as a completely ‘remote’ directional travel response, (i.e. without visual sight of keeper) to provide him with continued walking/running exercise behaviour. Food reinforcement at the desired destination was provided in advance of his arrival at that point, and in the absence of the keeper.

By pairing a third radio with the keeper and location and then removing the keeper, training progressed within a couple of training sessions and became an established behaviour. As an established behaviour, a variable ratio schedule of reinforcement can be applied, alternating food reinforcement at different points, establishing the option for consecutive travel between reinforcements, and the ability to vary the number of movements. A variable ratio schedule is defined in this context as a reinforcement schedule in which reinforcement is presented after a random number of correct responses (IMATA 2004). If desired, Putra Mas can participate in the radio directional travel training session remotely for consecutive travel with minimal opportunity to sight the keeper, reinforced with a food delivery.

#### *Details of radio communication system*

The radio used was a Hyteta Digital Migration radio with a frequency range of UHF: 400–527 MHz and a frequency stability of +0.5 ppm. Some difficulties have occurred if the volume on the different radios is equal and if the sound from different radios travels equally to the elephant. This can be confusing in terms of providing directionality to the elephant if the radios are in close proximity to one another. Solutions have included an increased distance between radios and volume adjustment of radios as required.

#### **Discussion**

This project began in July 2015. The original remote radio communication behaviour evolved into a library of multiple radio communication behaviours. These different variations in training sessions from the original radio communication can be done separately or combined in a training

session, as a completely ‘remote’ auditory challenge. This one concept therefore delivered an extensive variety of behaviours and challenges.

The project has provided good physical exercise and mental and auditory stimulation in the process of the enrichment training, with the elephant responding well to the behavioural enrichment training. The capacity for animals to be able to make choices within their environments has been a popular theme in recent discussions on the care and health of intelligent species. Challenges such as these deliver the ability for choice to Putra Mas, and therefore complement understandings of the ‘five domains of animal welfare’ (Mellor & Beausoleil 2015) in a fun, physical, and challenging program.

The project supplied sensory and cognitive stimulation for this male elephant, presented him with problem solving challenges and encouraged his investigation of the full extent of his enclosure. The level of success of this Asian elephant in performing tasks of auditory discrimination, memory and problem solving demonstrates the value of utilizing species-appropriate sensory, cognitive and physical opportunities for elephants in human care as suggested by the World Association for Zoos and Aquariums (Mellor *et al.* 2015).

A number of researchers have suggested that although experiments on elephant cognition have not supported widespread positive understandings of elephant intelligence (Nissani 2008; Plotnik *et al.* 2009), new ways of investigating elephant cognition need to be found (Bates *et al.* 2008) which are more appropriate to animals with different kinds of ‘higher order brain functions’ (Hart *et al.* 2008). Some argue that researchers have only made a small start in investigating elephant cognition in ways appropriate to their particular cognitive capacities (Bates *et al.* 2008). This project has sought to follow that direction by acknowledging and utilizing the species-appropriate abilities of the elephant. As an animal’s exposure to increased complexity of task and to challenges to the ability to retain complex memory concepts evolves, so does its ability to explore and reach its cognitive potential.

## Conclusion

This enrichment training project has been successful in providing sense and mental stimulation as well as physical exercise for the elephant and in addressing needs as set out within the *Five Domains of Animal Welfare* (Mellor & Beausoleil 2015). It follows pathways of natural sensory and cognitive abilities of elephants in order to provide enhanced opportunities for Putra Mas to use and demonstrate these abilities, and to explore his cognitive potential.

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