Ape Jam 2025

Exploring Cognitive Enrichment

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Bonobos (Pan paniscus) with aubergines at Twycross Zoo, UK. 2024.

Abstract

The workshop will explore how digital enrichment, including touchscreen technology, may be used to conduct research into the cognitive capabilities of great and smaller apes, facilitate welfare and enrichment opportunities and support a range of multimodal inputs and outputs, associated with the screen and the environment.

CCS Concepts

• **Human-centered computing → Interaction design process and methods**; • **Applied computing** → *Life and medical sciences*; • **Social and professional topics → User characteristics**; • **Computing methodologies** → *Artificial intelligence.*

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1 Introduction and background

Primates at zoos, including great and smaller apes, are known to benefit from cognitive enrichment [1], and the Ape Jam workshop explores how technology can support research in this area (see Figure 1).

There are many possible benefits of digitising enrichment, including the generation of larger, time-synched, more sophisticated data sets that can be used for research, the possibility of offering enrichment 24/7, and the use of algorithms to randomise events or

Figure 1: Chimpanzees at London Zoo, playing with puzzle boxes.

offer infinite types of challenges. Recent developments in animal-centred computing have levered AI and networking techniques for software development and repurposed existing hardware designed for humans as interfaces that enable other species to interact with systems.

1.1 Artificial intelligence

One well-established AI technique involves using computer vision to ID animal users and monitor their behaviour, if there is no available in-person observation. Examples include systems developed for zoo-housed gorillas [2], farmed animals, such as poultry [3], fish [4] and dairy cattle [5], as well as wildlife monitoring of big cats [6] and elephants [7].

Smart systems could respond in real time to animal performance and make appropriate alterations depending on the animals' behaviours. This technique is commonly used in computer games for humans, supporting dynamic difficulty adjustment (DDA) such that the game automatically increases or decreases the challenge for players depending on their ability. The purpose is both to create a satisfying experience for players, and to motivate them to continue playing and improving their skills. Such a system could be used to investigate perception or cognition in a specific context with different species. It could also act as part of the control centre in a networked system - see below.

1.2 Networking

An example of networked tech gaining wide acceptance in farming is herd management using virtual fencing and GPS-enabled collars , typically for cattle [8]. In wildlife surveillance, drones (which have a short battery life) can be deployed in fleets, each one part of a mesh system that enables seamless data capture across a landscape - data that can be subsequently analysed using machine learning (ML) [9-11].

With zoo-housed animals, networked tech could also be used to control multiple elements across enclosure zones, linking separate parts of systems with Bluetooth or radio signals that require no physical connection (wiring). Habitat complexity has been shown to be beneficial for many species, since it provides varying stimuli and encourages a range of behaviours. It can be achieved within a limited space by changing temporal, spatial or social aspects of the enclosure, to positively influence welfare [8]. A networked smart system could be designed to dynamically alter access to locations and associated resources, or randomise feeding and social opportunities.

These are all examples of systems designed as tools for humans, to facilitate their roles in monitoring, caring for and sometimes controlling other animals. Animal Computer Interaction (ACI) also explores the use of technology in designing systems explicitly for animals to use independently.

1.3 Interfaces

Computerized methods for cognitive enrichment, including primate touchscreen systems and software, draw on ACI principles to enhance animal well-being, support husbandry practices, and advance scientific understanding of animal cognition [13]. Originating in research laboratories, touchscreen tasks have been adapted for zoo settings to create dynamic problem-solving opportunities meant to resemble cognitive challenges that primates face in the wild. Since the Smithsonian National Zoo's Orangutan ThinkTank introduced frequent touchscreen use in the 1990s, zoos such as The Indianapolis Zoo, Lincoln Park Zoo, Edinburgh Zoo, Leipzig Zoo and Kyoto City Zoo have integrated these systems into the habitats of primates in their care, often in view of visitors [14-16] (see Figure 2).

Figure 2: Guests at Indianapolis Zoo, watching the chimpanzees using their touchscreens. 2024.

Touchscreens are intuitive to primates due to the direct interaction between stimuli and touch responses, offering precise, objective methods for engagement and data collection [17] (see Figure 3). Moreover, they provide the ability to offer detailed tasks on a flat screen without any small physical pieces that could be broken off and swallowed. Beyond enrichment, touchscreen tasks have also supported husbandry practices by assessing food and audio preferences, and they have even aided in physical rehabilitation, as seen in a case at Kyoto University where a chimpanzee's mobility improved when touchscreen tasks were offered to incentivize locomotion [18,19].

Recent advances in ACI have emphasized user-centric designs and stimulus reinforcement with projects like touchscreen soundboards and interactive projections at Melbourne Zoo, Kyoto City Zoo, and Zoo Atlanta [20-22]. Despite some challenges, such as diminishing utilization rates for computerized tasks that don't rely on food rewards, these technologies nonetheless have much potential to enhance well-being, by promoting mental and physical engagement [23,24]. The workshop will build on this foundation, exploring the design and implementation of digital enrichment to enhance well-being in apes.

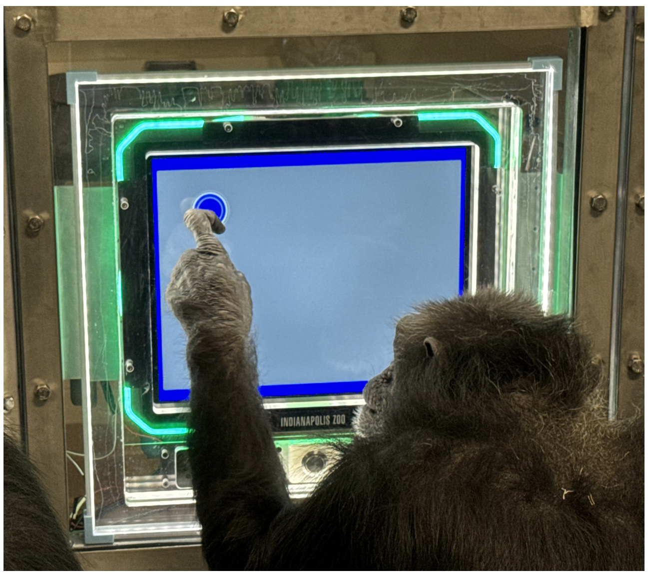

Figure 3: Cathy, a chimpanzee at Indianapolis Zoo, interacting with a touchscreen application. 2024.

One of the challenges facing designers is to develop enrichment technologies so that they are suitable for the many stakeholders involved, including the humans as well as the animals - for example, management staff, research staff, the animal carers who maintain the systems and the visitors who come for both education and entertainment. Another key consideration is how to evaluate any enrichment technology, based on clearly defined welfare, research and visitor-aligned goals. Our multidisciplinary field necessitates a broad approach, often resulting in data that is relevant for scientific, technical, sociological and philosophical outputs.

Our purpose therefore is to develop digital tech solutions for real enrichment problems in apes, taking into account these multiple factors.

2 Activities and motivation

In the morning, participants will visit the great ape enclosures at Indianapolis Zoo, to observe a community of chimpanzees first hand and experience their environment, and to see some touchscreen equipment on location.

They will be given a set of briefs for different ape species, provided by relevant animal experts, which require them to devise enrichment challenges that incorporate various forms of interactive digital systems, including touchscreen technology. The goals of the enrichment will be to support the animals to express their natural behaviours, and also to answer specific research questions relating to great and smaller apes.

After a lunch break, participants will address the briefs in turn, collaborating to share knowledge and ideas. After a period of brainstorming together, they will align around their selected briefs to form teams and produce detailed designs. These might include a storyboard or flow diagram for an interactive application, crafted 3D models of artefacts in the ape environment, video mock-ups or any other kind of media that showcases the concept so that it is accessible to others. The proposals must include a clear rationale for design choices and a viable method for evaluating effectiveness in relation to the stated goals.

We will then ask groups to design a poster that showcases their work, which can be displayed during the rest of the conference. Finally, we will have a short plenary, where teams present their ideas and animal experts offer feedback.

3 Proposed Outputs

- A set of collaborative designs that address specific welfare, enrichment and research goals relating to apes, shared on a dedicated public website: https://zoojam.org/apejam [25].
- We anticipate that some of the designs addressing the briefs will lead to future prototype developments and testing with their potential users – both apes and humans. With this in mind, we will offer participants the chance to sign up for short coding tutorials, showing how to program a specific well-used ape touchscreen system.
- A series of case studies built around concepts that can be built and tested with apes.
- Optional co-authorship of a paper addressing the research questions arising from the briefs, including an evaluation of the different digital technologies proposed as solutions to the welfare and enrichment goals.

4 Workshop Committee

- Fay Clark, Senior Lecturer, School of Psychological Science, University of Bristol, UK.
- Fiona French, Associate Professor, School of Computing and Digital Media, London Metropolitan University, UK.
- Simon Kenworthy, Researcher, The Zoological Society of London, UK.
- Christopher Flynn Martin, Director of Research, Indianapolis Zoo, Indiana, USA.
- Yumi Yamanashi, Principal Researcher, Center for Research and Education of Wildlife, Kyoto City Zoo, Japan.

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Zoo Jam website: https://zoojam.org/apejam/

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