Cat Royale: A Case Study of Artist-led AI Research

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Abstract: We explore artist-led research as a method to complement technical AI methodologies. We present a case study called Cat Royale in which artists created a robot to play with cats. We show how the artist-led development of this system involved extensive improvisation to create a socio-technical AI system that ultimately delivered a corpus of video data of cats interacting with robots. We introduce a machine learning tool that enables diverse stakeholders to explore this corpus. We reflect on the distinctive characteristics of artist-led AI research, the potential benefits to AI, and the tensions involved.

Keywords: Art, AI, Artistic-AI, Artistic Methods, AI Methodology, Robots, Animal Behaviour.

1. Introduction

Artificial Intelligence (AI) is transforming the arts and machine learning in particular has proven to be a powerful tool for contemporary artists [1, 2], although it has also raised concerns over intellectual property and job dislocation [3, 4]. However, there has been less discussion of the converse relationship—*how can art transform AI*? We address this question by considering how artistic practice can serve as a productive AI methodology to complement data-driven technical methodologies. We do this through a case study of an artist-led exploration of AI (specifically robotics) that generated a groundbreaking artwork while also serving as a research project. Cat Royale was an artwork that explored the question of whether we should trust AI to care for our loved ones by creating a luxurious 'cat utopia' for a family of three cats, at the centre of which a robot tried to increase their happiness by playing games with them. A key outcome of the artwork was a novel corpus of video data of cats interacting with robots which inspired the development of a tool to enable diverse researchers to better explore and analyse the data. We reflect on this case study to articulate the distinctive nature of artist-led AI research, identifying potential benefits to AI research more broadly, while also noting key tensions that it raises. We argue that recognising the value of art to AI may open up new opportunities for the creative sector.

2. Related Work

2.1. AI methodology

Methodology in AI broadly refers to the technical processes and methods used to create intelligent systems. There is no single AI methodology, but rather a collection of methods including machine learning, deep learning, natural language processing, computer vision, genetic algorithms, and evolutionary algorithms among others, each combining techniques from computer science, mathematics and statistics, often inspired by concepts from cognitive science and neuroscience. While different in their specifics, these methods can be broadly characterised as following a process of problem definition, data collection, data pre-processing, model selection and algorithm design, model training, evaluation and testing, deployment and verification, followed by continuous improvement. Underlying them are some important assumptions: that the problems we wish to solve are known in advance; that suitable data is available beforehand; and that there is an objective function representing a true and verifiable solution.

Critiques of AI's methodologies date back nearly as far as AI itself. The philosopher Hubert Dreyfus critiqued Classical AI for assuming that the human mind works by performing discrete computations on symbols, that all activity can be formalised mathematically, and that reality comprises mutually independent atomic (indivisible) facts [5]. Dreyfus argued that, to become truly intelligent, AI would need to be physically and socially embodied in the world, a view subsequently echoed in works such as Hutchins' theory of 'distributed cognition' [6] and Brooks' call for robotically embodied AI [7]. Even though AI's methodologies have since radically shifted to the data-driven approach of machine learning, these core assumptions remain in place. Moreover, new methodological critiques have emerged, notably ethical concerns around fairness and bias arising from inappropriate data [8], leading to calls to better document data provenance [9].

2.2. AI Art

We consider how art can extend AI's methodologies, potentially enabling them to respond to the above critiques. While the history of AI Art dates back to the earliest days of AI itself, for example the ground-breaking work AARON from the late 1960s [10], the recent emergence of Large Language Models (LLMs) and text-to-image diffusion models has fuelled an explosion of interest in AI-generated art through the widespread use of publicly available platforms for generating images (e.g., Google Imagen 3[1]), music (e.g., Suno)[2] and video (e.g., OpenAI Sora[3]). In turn, this has raised further ethical critiques of AI concerning intellectual property [11], job dislocation in the creative sector [3, 4], and the extent to which AI can be considered a creative artist or co-creator [12], concerns raised publicly by high-profile musicians [4] and campaigns[5]. Various authors have discussed the relationships between artists and AI. Salimbeni et al. identified perspectives adopted by AI artists: employing AI as a tool for co-creativity, considering it an autonomous artist, creatively playing with data, and investigating and often critiquing AI as the subject of their work [12]. In a review of AI-generated visual art, Sivertsen et al. revealed how artists subvert AI's technical methodologies by selecting 'inappropriate' training data or overfitting or underfitting models so as to deliberately introduce ambiguity, thereby challenging widespread assumptions about the need for certainty, correctness and explainability [13]. Benford et al. consider how artists challenge the assumptions that underlie the technical methodologies of AI, focusing on ambiguity above certainty, interpretation above explainability, improvisation above dependability, surrender above control and playfulness above safety [14].

2.3. Artistic practice as a technology research method

Artistic practice is increasingly recognised as a productive research methodology that contrasts with established scientific methodologies. In the arts, practice-led research begins with creative artistic explorations, before reflecting on these to generate new knowledge, with research goals and questions often being unclear at the outset and only emerging through the artistic process [15]. Creative, practice-led research methodologies have migrated from the arts into the field of Human-Computer Interaction (HCI) under the broad umbrella of Research Through Design [16, 17]. Of particular relevance here is the methodology of Performance-led Research in the Wild where professional artists create new artworks or installations, while technology researchers help them realise these technically, before reflecting on their artistic rationale and process and on audience engagement to distil new design principles for digital technologies [18].

[1] deepmind.google/technologies/imagen-3/
[2] suno.com
[3] openai.com/sora/
[4] theguardian.com/music/2025/jan/27/elton-john-paul-mccartney-criticise-proposed-copyright-system-changes-ai
[5] newsmediauk.org/make-it-fair/

3. Cat Royale: a case study of artist-led AI research

In August 2020, the UKRI funded the Trustworthy Autonomous Systems Hub (TAS Hub[6]), a UK research programme focused on investigating how autonomous systems can be created to be trustworthy by design. As part of this endeavour, the TAS Hub recognised that this goal required the involvement of diverse stakeholders including the public. To achieve this, the TAS Hub Creative Programme was born as an initiative aimed at using creative means of engaging the public and mainstream media. The artists Blast Theory were engaged as the TAS Hub's Creative Ambassadors and were invited to create a high-profile work to engage the public with the question of trust in autonomous systems. Their response was Cat Royale [7].

3.1. An overview of Cat Royale

The artists created what they ambiguously called a 'cat utopia', a bespoke environment inhabited by a family of three cats, Ghostbuster (father), Clover (female offspring) and Pumpkin (male offspring), that was intended to cater to their every need. Following the advice of animal welfare experts, the artists designed an enclosure containing ample feeding stations, litter trays, sleeping areas, perches and raised walkways at the centre of which was a robot arm whose task was to enrich the cats' lives by playing games with them. In order to ensure the cats' safety, we chose a small robot (a Kinova Gen3 lite arm) with a short range (0.76 meters), low payload (0.5 kg) and a two-finger gripper that could pick up different toys.

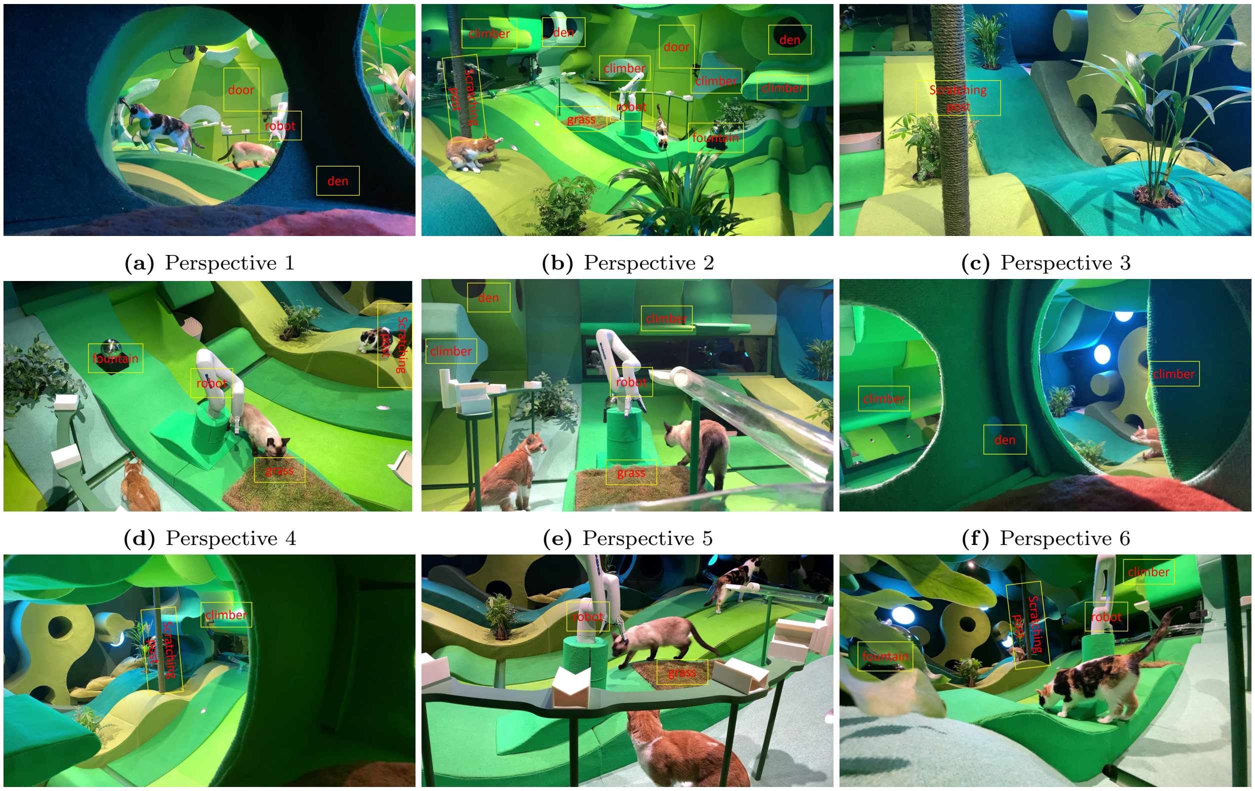
Every ten minutes, the robot wielded a toy, following a sequence of pre-recorded moves, while the artists, observing from behind the scenes, scored the cats' responses using the Participation in Play scale [19], a recognised instrument for measuring feline play, feeding the results back into a 'decision engine' allowing the artists, the robot, and its underlying systems to learn the cat's preferences and favourite games. Also located behind the scenes, a human robot operator monitored that the robot was behaving safely and would sometimes step in to improvise movements when the robot became stuck, for example when it became tangled with the toys. The cats spent six hours a day for twelve days in the environment, engaging in over 500 playful games with the robot. They were continuously filmed via eight iPhones (a mixture XR and 11 models) deployed at fixed positions, with the footage being edited into highlights for social media[8] and an eight-hour long film that has toured galleries worldwide.

3.2. Cat Royale as a research project

Cat Royale was a research project as well as an artwork, following the method of Performance-led Research in the Wild described earlier. Initial articles from the project focused on how the work surfaced new requirements for designing *multispecies robot worlds* environments to accommodate robots, humans and animals, in which AI and humans would collaborate to deliver care for the animals [20], alongside wider reflections on the complexities of ethical review processes for multispecies research [21]. These articles made contributions to the fields of Human-Computer Interaction and Animal-Computer Interaction. The question we consider here is the contribution to AI research.

The artists and wider research team had been keen to explore the potential of AI from the outset. Initial thoughts were to develop a computer vision system that could help monitor the cats' safety by predicting when they were approaching the robot (entering proximity or even crouching ready to pounce), or measuring how happily the cats were playing with the robot so that it could learn which games and movements they preferred, recommend new ones, or even generate new movements. However, given the lack of available training data on cats playing with robots, rigorous safety requirements, and the need to deploy a fully integrated and working system within a tight timescale, the final system required extensive human involvement to deliver these functions. A robot operator and a cat welfare officer monitored the cats' safety from a control room behind a one-way mirror. The robot operator continually pressed a dead man's switch for the robot to proceed with its pre-recorded movements and sometimes needed to improve new movements to untangle the robot. The artists manually scored the cat's play, feeding the results into a rule-based system that recommended new games. They also manually created new movements in response

[6] tas.ac.uk
[7] Introductory video at: youtu.be/yBvHzsIgNRk
[8] youtube.com/watch?v=Un-bet9CFIQ&list=PLNEbg2a9DdkrlsKwPCq8JQDlekE7MGJrK



(a) Perspective 1 **(b)** Perspective 2 **(c)** Perspective 3

(d) Perspective 4 **(e)** Perspective 5 **(f)** Perspective 6

(g) Perspective 7 **(h)** Perspective 8 **(i)** Perspective 9

Figure 1. Camera Perspectives. **1a:** Close-up from inside floor-level sleeping den. **1b:** Overview of the main area with the robot, water fountain, scratching pools and plants visible. **1c:** Close-up of the scratching post, plants, and the back wall. **1d:** Top-down view of the robot area. **1e:** Side view of the robot area, entrance of the ball run and toy rack. **1f:** Close-up from inside a high den. **1g:** From within a second den, emphasising the scratching post and climbing areas. **1h:** The toy rack, robot, ball run, and central play area. **1i:** The robot seen from a low angle.

to their observations. In short, while Cat Royale successfully deployed a physical robot to play with cats, the intelligence behind the robot was largely human, not artificial.

3.3. The Cat Royale dataset

However, a further key outcome of Cat Royale, which was not anticipated at the outset, was to deliver a rich dataset from which future AI systems might now learn.

Video data collection. Cat Royale yielded a unique dataset of cats engaged in a wide variety of activities, including playing with the robot, drinking, sleeping, grooming, scratching, and play fighting. The core of this was over 5TB of video data comprising 576 hours of footage captured from eight iPhone cameras at 30 fps and 1920*1080 resolution using the HEVC/H.265 codec. Seven cameras remained static throughout, while one was knocked and misaligned by the cats and so captured two different perspectives at different times. Camera positions were chosen to maximise coverage of the enclosure and capture the widest possible range of activities while providing overlapping views of key areas, especially the robot (see Figure 1). Video data was supplemented by manually generated logs for each of the (over 500) games played, including a time-stamped record of which toy/game was deployed and the artists score of how the cats engaged using the Participation in Play Scale. This was further supplemented with frequent reports from the Cat Welfare officer using the Cat Stress Scale [22]. The wider corpus of data also includes field observations (including additional video material recorded in the control room), interviews with key stakeholders, and documentation of the artists' development process including a 3D graphical—and physical—model of the enclosure.

Frame decimation and model training. We applied machine learning to develop a prototype tool for visualising and interacting with the data. This allowed the team to engage with the data and discuss it with key project stakeholders, thereby exploring potential uses and further developments of this dataset.

Following initial experimentation, we performed frame decimation to only sample one frame per second. This resulted in an acceptable trade-off between accuracy, time consumption, and storage requirements, resulting in a sampled data size of approximately 6 GB per 3-hour long video. Frame decimation to below .33fps, resulted in frequent missing of cats as they rapidly traversed camera views. Conversely, greater than 2fps significantly increased the storage space required and analysis time.

Following the frame decimation, we used a human-in-the-loop approach to dataset annotation, in which an existing object detection model was used to generate initial ground truth data, which was then corrected by a human annotator. We evaluated several popular models for object detection, including You Only Look Once (YOLO) [23], Single Shot Multibox Detector (SSD) [24] and Faster R-CNN [25]. We selected Faster-RCNN as our final model, which as a region-proposal-based model offers lower efficiency but improved accuracy on a small number of targets [26]. Evidence also suggests that Faster R-CNN offers higher performance on occluded animal targets [27], a common occurrence in our dataset. While single-shot detectors such as YOLO are often more efficient, this was unnecessary since annotation did not need to be conducted in real-time.

Cat Recognition and Regions of Interest (ROIs). To detect individual cats and Regions of Interest (ROIs) within the environment, we used the open source Detectron2 [28] framework and applied a pre-trained Faster-RCNN model on randomly selected frames, before using LabelMe [29] to correct erroneous label suggestions. The model was then retrained with the corrected dataset before being used to recognise further images. This process was repeated until a total of 4320 correctly labelled frames were collected. Following the training, the model was applied across the larger dataset to identify the cats. Analysing a 3-hour video took between 2–3 hours on an Nvidia A4000 GPU.

We manually labelled static Regions of Interest (ROIs) within the environment, specifically: the robot, litter tray, water fountain, scratching post, grass, sleeping nest, right climber, left climber, walkway, and the door. To identify whether a specific cat was present in a given ROI at a given time, we analysed multiple camera views. If the cat was detected in more than half of the cameras covering that ROI—as we defined the certainty threshold to 50%—we considered it present in the region at that time.

Model evaluation. Our evaluation of the model was carried out on the Computer Vision Laboratory's GPU Cluster at the University of Nottingham using SLURM Workload Manager: CentOS (v. Linux release 7.9.2009), Conda (v. 23.10.0), Python v. 3.8.18, Detectron2 v. 0.6, OpenCV v 4.7.0, Torch v. 1.12.1, CUBA v. 11.7, GCC v. 10.2.0, GPU NVIDIA RTX A4000 with two GPU cores, and eight CPU cores. The average precision and recall for classifying the cats were 0.71 and 0.82, respectively[9]. Pumpkin's fawn colour made it the easiest to be identified against the green/blue background (lowest False Negatives). However, at times the toys were classified as Pumpkin (highest False Positives). For Ghostbuster, whose colour is creamy, we observed the opposite tendency.

Cat Identification through Video Analysis (CIVA). To enable various stakeholders in the project to better understand the dataset and explore future applications and challenges, we created a GUI-based interactive visualisation platform called CIVA (Cat Identification through Video Analysis) (see Figure 2). CIVA allows users to select combinations of cats, ROIs and timescales, and generates various visualisations in response. An example visualisation of cat activity—focusing on Pumpkin's time spent at the Water fountain, the Robot, and the Grass ROIs—can be seen on the left side in Figure 4 (Pumpkin on the 20th of March). This visualisation highlights that Pumpkin spent significant time near the robot, compared to the other two ROIs chosen in this comparison (yellow line).

An alternative representation employs radar plots (see Figure 4 right) to compare the cumulative times spent by the various cats across all ROIs. The final view currently supported by CIVA overlays heatmaps of cumulative time on video frames (see e.g., Figure 3). These example visualisations were not intended

[9]Precision and recall varied for the individual cats. The average precision for the identification of Ghostbuster had the highest average precision (0.75), while Pumpkin had the highest average recall (0.84).

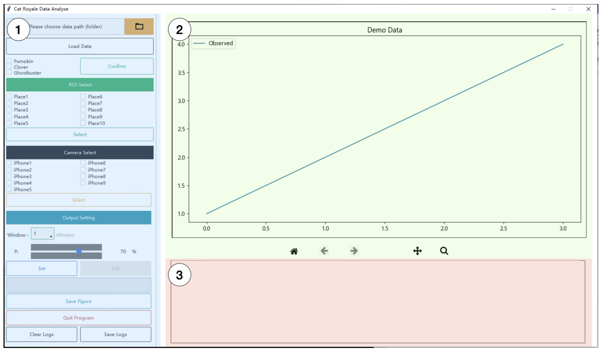


Figure 2. The CIVA system: 1) parameter selection (blue), 2) visual output (green), and 3) data log (red).

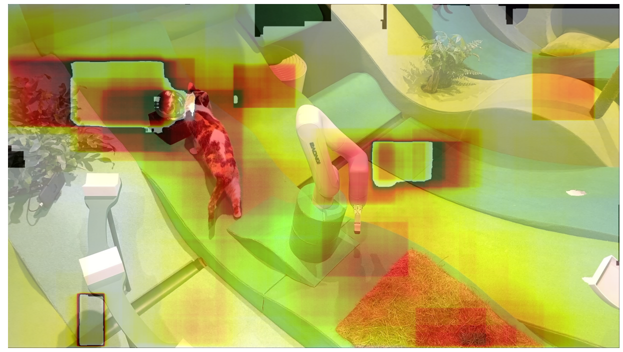


Figure 3. Heat map for Clover based on the perspective of Camera 4.

to present an exhaustive analysis of animal behaviour, but rather aimed to stimulate our stakeholders to imagine the kinds of analysis that might be possible in the future.

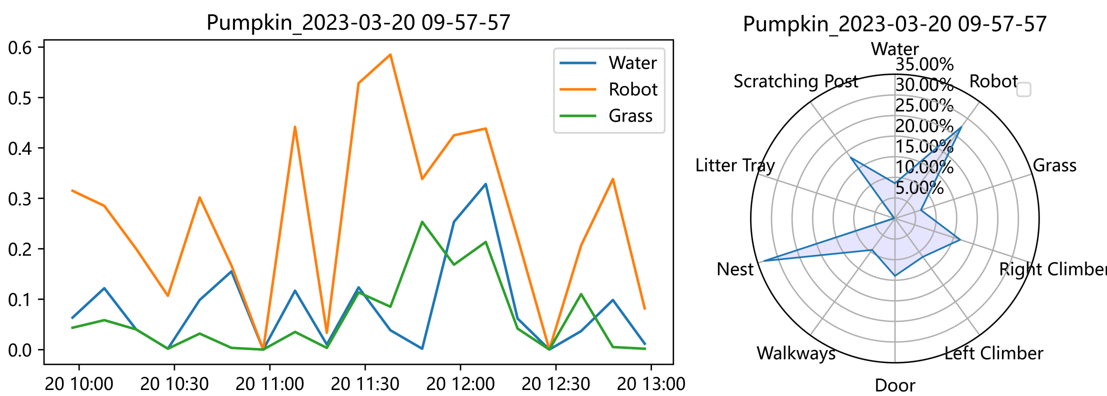


Figure 4. *Left:* An example representation of Pumpkin's presence near a specific selection of ROIs, specifically: the Water fountain, the Robot, and the Grass. *Right:* Radar plot of how Pumpkin spend her time overall.

Initial responses to CIVA. We presented CIVA to five stakeholders of the Cat Royale project: one of the artists, an animal behavior researcher, an Animal-Computer Interaction (ACI) researcher, a computer scientist, and a roboticist—interviewing them for an average of 45 minutes each to explore potential applications of the data set and identify potential applications and technical challenges that might arise. The artists, who had previously manually edited the Cat Royale movie and video highlights, anticipated how AI might help them better find stories of interest (e.g., all clips of Clover and the robot); might automatically edit the footage, especially if it could learn from how the human vision-mixer had done this; and might enable audiences to also better locate and watch key highlights. The two animal-focussed researchers suggested that the tool could summarise the cats' behaviours; help them identify key clips for subsequent manual analysis; and potentially be trained to automatically recognise specific cat behaviours such as playing, feeding, sleeping and scratching. They also speculated about the potential to develop future animal monitoring and care systems. The computer scientist and roboticist focused on how the dataset posed new challenges for AI video analysis and robotics, looking beyond current research in tracking animals and pose estimation towards behaviour recognition arising from datasets that showcase complex interactions, all consistently filmed from multiple angles.

4. Discussion: Artist-led AI research

We reflect on Cat Royale as a case study of artist-led research applied to AI, considering the distinctiveness of the approach, the potential benefits it offers, and the challenges it poses to AI research.

4.1. The nature of artist-led AI research

As noted earlier, the relationship between AI and art is not a new one; there have been many examples of employing AI to make art which in turn have demonstrated the capabilities of AI, raised questions and critiques, or served to shape the technology in some way. However, Cat Royale is distinctive in how it balanced making art with robotics and AI *research*, differing from AI methodologies by being artist-led and from many AI artworks in having an explicit goal to deliver research outputs and involving researchers throughout. We highlight key characteristics of Cat Royale as artist-led research.

The project was funded under a technology research programme and so was deeply embedded in AI research culture from the outset. However, it was artist-led, with Blast Theory being given free licence to determine the nature of the artwork. Their process was open-ended and exploratory; the idea to work with cats emerged after six months while specific problems, objectives and research questions were not identified in advance beyond the broad goal of exploring public trust in robots. The artists adopted a nuanced stance towards AI, embracing the technology while inviting audiences to consider it critically.

In their turn, researchers played a dual role within the process, initially enabling the artists to realise their vision technically, before documenting and reflecting on their rationale, process and the audience's experience in order to distil research findings (e.g., the idea of designing multispecies robot worlds).

The method involved extensive improvisation of a socio-technical AI system. It was not possible to fully meet the artists' initial technical requirements given available data and time, so humans needed to step in to fill in the gaps. This shares similarities with the 'wizard of oz' methodology that is employed in robotics research [30], but at a scale and intensity that delivered a fully functioning experience sustained over many days. Finally, we note how research was multidisciplinary, drawing on and contributing to human-computer interaction, human-robot interaction, animal-computer interaction, the humanities, and AI and robotics.

4.2. Potential benefits of artists' involvement to AI

We propose that this artist-led approach to the investigation of AI, its capabilities and limitations, can offer a breadth of potential benefits to AI research that complement established methodologies.

While research, technology development and academic writing—skills familiar to computer scientists, roboticist, animal-computer interaction specialists, and other academics—require creativity, the distinct creative expertise of artists introduces a unique and valuable perspective. Artists imagine unusual applications for AI, especially, emerging technologies, making their involvement invaluable. Collaborating with artists, provided they have artistic freedom, therefore provides a new and unique opportunity to investigate and test technology with unexpected applications and results.

Artistic practice often goes hand-in-hand with 'artistic thinking' that typically celebrates subjectivity, ambiguity, being open to multiple interpretations, improvisation and playfulness. Cat Royale's overall framing as a 'cat utopia' and the idea of measuring cats 'happiness' were both highly ambiguous, defying simple 'correct' interpretations. Such thinking can broaden AI's conventional conceptual foundations that emphasise correctness, dependability and safety, providing responses to the critiques noted previously (see Section 2). The subjectivity inherent to art can highlight the perspectives and experiences of marginalised constituencies—animals in our case— drawing attention to fairness and bias and making the inherent positionalities (and political nature) of AI more apparent, especially to the public. This subjectivity extends to the CIVA tool that opens up the Cat Royale dataset to diverse human researchers to analyse video from different positions (e.g., animal behaviour, robotics etc).

The resulting artworks may deliver extensive public engagement as they continue to tour once initial production and research has finished. Researchers may benefit from powerful impact stories backed up by evidence of audience numbers, venues, additional funding through commissions, awards and critical acclaim. In turn, artists may benefit from co-authorship of research outputs which may ultimately enable them to act as independent research organisations in projects (Blast Theory appear as co-authors of technical papers from Cat Royale and have been funded in several EU and Innovate UK projects).

Importantly, AI artworks delivered at scale can yield rich and unusual new datasets for the wider AI community. This reverses the conventional approach to AI in which the availability of data precedes the development of systems and then experimental validation. In Cat Royale, the absence of suitable data at the outset necessitated the improvisation of systems, which ultimately delivered new data. Moreover, capturing rich documentation of artworks is a widely researched topic in the humanities [31], with the implication that humanities scholars may have an important role to play in extending current approaches to capturing and structuring artistic datasets for AI.

4.3. Challenges of artist-led AI research

Artist-led AI research is also challenging, requiring new approaches to blending the arts with computer science. There are myriad practical challenges to be negotiated. The adventure of artist-led research brings a degree of risk, with success depending on public delivery of working performances to real audiences according to strict deadlines; a degree of rigour that far exceeds conventional technology demonstrations. Further risks arising from touring include securing opportunities to perform and managing the complexities of being on the road. A further challenge with touring concerns how researchers can hand over the technology to artists so they can operate it independently.

The process, from initial explorations, to premier performance, subsequent touring, and delivering research, takes a long time; Cat Royale took 18 months from initial exploratory workshops to performance, and we are still writing up research results two years later. It can be difficult to balance funding for projects. AI research funders may be tempted to view the approach as public engagement more than research (as was initially the case for Cat Royale), while it is also important for artists to secure commissions and arts funding for production and touring, in part to demonstrate the artistic legitimacy of the work. It is also important to ensure fair payment for the artists. Research funders often view industry partners as contributing funding (direct or match) to a project rather than being paid. However, as small independent companies, it is important that artists are fairly remunerated for participating in research.

Other challenges are more fundamental in nature. There is a clear epistemological tension between science and engineering, on which AI conventionally draws, and the arts and humanities. With the artist-led approach, research questions may only emerge during the process while evaluations may be qualitative and highly subjective. It can be difficult to persuade the 'scientific' community to recognise the validity and value of such contributions, making it necessary to clearly and explicitly clarify the methodology. A further challenge is ethical review which needs to consider issues arising from engaging audiences with sometimes provocative experiences. The distinctive ethical considerations of artist-led research have been articulated in [32], while Cat Royale was notable for its 18-month long ethical review process (in large part because it also involved animals) which had to negotiate various epistemological tensions as reported in [21].

Through decades of experience, we have developed a three-stage pipeline through which we negotiate these various challenges. The first stage is *residencies* in which we fund artists to spend time in our lab, building relationships and exploring technologies and ideas in an open-ended way. The second is *productions*, in which both we and the artists fund the development of a new work to the point where it premieres and we can capture research data. The third is *touring*, where additional development enables artists to tour a work independently, delivering additional research impact.

5. Conclusion

The case study of Cat Royale reveals how artist-led research can be a distinctive and productive research method for AI. It's distinctiveness lies in enabling artists to pursue an exploratory and improvisational approach to delivering functioning AI systems that work 'in the wild' of public performance. Unlike conventional machine learning models in which the availability of data precedes models, this approach delivers unusual datasets as an output of the project that may then raise new challenges for the wider community. There are also tensions inherent to this approach, the most immediate of which lies in recognising it as a legitimate research method despite its epistemological differences to conventional techno-centric ones; in short AI researchers need to be open to exploratory approaches in which new problems and data emerge throughout that can complement focusing on solving standardised and benchmarked challenges.

Future work for Cat Royale includes preparing an open dataset for release to the research community to enable research into AI (e.g., challenges in computer vision concerning pose and activity detection for cats) and animal behaviour research (e.g., comparing participation in play with the robot compared to previously reported findings). More generally, future work includes new artist-led projects exploring close physical engagement between robots and other species, including humans.

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