# The Day After: Ethical Considerations for the End of Enriching Animal Research Projects

Jennifer Cunha
Parrot Kindergarten, Inc.
Jupiter, Florida, USA
jen@parrotkindergarten.com

Clara Mancini
The Open University
Milton Keynes, United Kingdom
clara.mancini@open.ac.uk

## Abstract

This study investigates the potential for parrots to engage in functional communication using speech board interfaces. We examine whether the interactions of a Goffin's cockatoo with her speech board correspond to established functions of communication identified by Jakobson's linguistic model and whether there is correspondence with biological functions in animal communication. Additionally, to explore the bird's intentionality we examine her persistence in making requests via speech board selections, her ability to seek out displaced representations of preferred foods, and her response to unexpected outcomes. Our findings suggest that the cockatoo's interactions with the speech board align with established linguistic and biological communication functions, and indicate intentional communication on her part. This has implications for studying parrot cognition and, thus, for designing speech board interfaces that might better support parrots' communication abilities.

## CCS Concepts

• **Human-centered computing** → Interaction design; Empirical studies in interaction design.

## Keywords

Animal-Computer Interactions, Speech Board Interactions, Parrot Communication

**ACM Reference Format:**
Jennifer Cunha and Clara Mancini. 2024. The Day After: Ethical Considerations for the End of Enriching Animal Research Projects. In *The International Conference on Animal-Computer Interaction (ACI 2024), December 02–05, 2024, Glasgow, United Kingdom.* ACM, New York, NY, USA, 8 pages. https://doi.org/10.1145/3702336.3702345

## 1 Introduction

Ethical considerations when conducting research for and with animals are of primary concern for the ACI community (e.g. [24], [7], [14], [4]). However, the focus has so far been almost exclusively on what happens during the research as a result of researchers' interventions, rather than what happens as a result of withdrawing researchers' interventions once the research comes to an end. While researchers have argued that animal-centred research requires considering the broader implications of research and design activities (e.g. [15], [26]), this position paper focuses specifically on the ethical considerations that arise due to the potential impact of withdrawing enrichment provided to animal participants for the purpose of conducting research studies. There is evidence that losing enrichment may negatively affect animals resulting in their welfare being even worse than it was before enrichment was provided [29]. However, whether for practical, scientific or legal reasons, it is sometimes necessary for researchers to discontinue the provision of enrichment beyond the duration of a research project. Through the case study of a Goffin's cockatoo who, for a period of time, was provided with an enrichment intervention that was subsequently withdrawn [10], we reflect on how the risk of withdrawal might be assessed against ethical principles proposed by ACI researchers [16] and how researchers might address those risks in different scenarios, when preparing research plans for ethical approval and when reporting on research activities.



*ACI 2024, December 02–05, 2024, Glasgow, United Kingdom*

ACM ISBN 979-8-4007-1175-6/24/12
https://doi.org/10.1145/3702336.3702345

## 2 Background

### 2.1 Animal Research Ethics

Since 500 BC, animals have been subjects in research, with their use in experiments for the production of food, drugs, cosmetics and other products eventually becoming a legal requirement in many countries (e.g. [1]). This poses a fundamental ethical dilemma arising from the assumption that animals are unable to consent to procedures that can harm them but that are considered necessary to achieve a greater good. To address this dilemma, and in response to mounting evidence of many animals' sentience and capacity to suffer harm, in 1959, Russel and Burch [22] proposed the ethical principles of Replacement, Reduction and Refinement (3Rs). Now widely recognised as the gold standard for humane research, the principles require: that animal methods be replaced with non-animal methods or that more complex species be replaced with less complex species in research procedures whenever possible; that the number of animals involved in research procedures be reduced to the minimum needed for statistical power; and that all research procedures be refined to minimise the impact on animals before, during and following procedures. Among other measures, the application of the 3Rs is generally regarded as instrumental for improving the harm-benefit balance (i.e. the balance between harms to animals and benefits to society) of research procedures [11] and some ACI researchers have also recommended their application when conducting studies with animals [25]. However, others have argued that, while fostering the humane treatment of animals during research, the 3Rs essentially reflect a process-centred perspective and are thus insufficient to support ACI's animal-centred values, for example because they dismiss animals' ability to consent or dissent to their involvement, or because they still regard animals as substitute-able components of experimental apparatuses ([14]). Instead, above and beyond complying with the 3Rs, ACI researchers have highlighted the importance of considering the unique experience of individual animals, of safeguarding their integrity and of enabling their agency during research activities (e.g. [13], [30], [8]), on the grounds that pursuing animal-centred design requires the employment of animal-centred research methods [14].

To this end, researchers have proposed ethical principles to assess the design [16] and inform the iterative refinement of research activities involving animals [19]. These comprise: relevance, which requires working only with animals for whom the research is directly relevant and beneficial; impartiality, which requires protecting all participants in virtue of their role rather than their characteristics (e.g. age, sex, species, or assumed levels of sentience); welfare, which requires ensuring all participants' physical and psychological well-being at all times; and consent, which needs to be obtained from all participants, including animals. For the authors, animals' consent takes two complementary and equally necessary forms: mediated consent, obtained from human guardians who know the animal well and understand the implications of their involvement, who have their best interests at heart and the legal authority to decide on their behalf; and contingent consent, provided by animal participants who must be allowed to continually assess the situation and choose what to do, whether and how to engage, while appropriate monitoring of any manifestations of dissent should enable guardians to respond accordingly.

Alongside these normative approaches, ACI researchers [20] have also proposed tools to help researchers articulate their and their projects' ethical baselines, and make ethically sound situated decisions when they face unexpected, ethically charged situations, requiring them to make impromptu decisions. These tools enable researchers to develop a series of ethical guiding statements to which they can subsequently refer when making decisions during the research (e.g. on how they are, could be or should be interacting with the animals involved), to ultimately foster a practice of active reflection within research teams, helping researchers to maintain their commitment to a project's animal-centred ethos.

However, although much attention has been paid in ACI to developing ethical frameworks and tools to support the design of animal-centred technology and the methods employed in the process, there has been little discussion of the ethical implications of withdrawing or discontinuing technological interventions once research projects come to an end. These implications are not typically considered in animal research in general because usually at the end of procedures animals are killed, unless they are reused for new procedures (e.g. [2]). However, this is of course not the case with ACI research studies, after which normally animals go on living in their habitual environments. Thus, when projects come to an end, and if interventions are terminated, the question arises as to what impact this might have on the animals who have been involved in the research and have experienced the intervention. The question is particularly pertinent when interventions specifically aim to enrich the animals' experience and when they are designed to meet the welfare priorities of animals who live in environments that otherwise fail to meet said priorities.

## 2.2 Enrichment and Loss

From searching for food, to avoiding prey, and finding mates, in the wild, animals are afforded the opportunity to engage in naturalistic behaviors and biologically relevant cognitive challenges. In captivity, such affordances are often traded for safer but impoverished environment, which provides better healthcare, poses fewer threats, and sometimes delivers longer lives, but affords fewer opportunities to engage in meaningful activities [27]. More recently, researchers have expanded the way in which they stimulate naturalistic behaviour through the use of technology and computer interactions [17]), as these can provide varied sensory experiences and mental challenges that would naturally occur in the wild, and are hard to emulate with natural materials alone [29]. Use of technology for mental stimulation has proven more persistent–lasting years–among primates than other forms of potential mental enrichment, such as puzzles, mirrors, music and movies [29].

In the absence of appropriate stimulation, many animals in captivity develop 'stereotypies' - seemingly repetitive, invariant movements that have no functional or observable use (e.g. [9] [21] [18]). These may include excessive pacing, rocking, vocalizing, over-grooming, or even self-mutilation. Stereotypies are thought to develop due to lack of opportunities for animals to engage in natural behaviors, as a way of coping with the prolonged experience of an unfulfilled biological need [12]. For instance, stereotypic digging in caged gerbils results from a lack of structures for burrowing [31]; feather-plucking in hens who are unable to forage is identical to foraging pecks [3]; and chewing of cage bars in mice arises from futile attempts to escape [6]. When enrichment that promotes naturalistic behavior is provided to individuals at a young age, stereotypic behaviors are less prevalent and severe; while animals raised without enrichment and then provided with such after the development of stereotypies generally show reductions in their presentation, depending on the kind of enrichment offered and on the animals' age (elderly animals being more resistant to beneficial effects) [12]. Generally, though, the provision of enrichment reduces stereotypic behaviors, highlighting its benefits. But what happens when enrichment is taken away?

There is copious literature on the detrimental effects of removing enrichment from captive and laboratory animals who previously could access it–the results being fairly unpredictable [12]. Where enrichment provides a buffering effect against deprivation and other stressors, after extinction effects animals who were previously enriched exhibit higher levels of frustration and stereotypies that persist. In other words, providing enrichment and then removing it can itself induce stereotypic behavior [12]. In fact, the effect of the removal of complex naturalistic enrichment seems to result in stereotyping that is more severe and prevalent than in individuals who were never provided it to begin with. For instance, removing straw from pigs who were previously provided with it causes more extreme tail-biting behavior; wild-caught birds brought into captivity exhibit greater route-tracing behaviors than birds born in captivity; and removing temporary enrichment from primates increases their stereotypies to levels higher than before they were provided the enrichment [12]. In particular, primates who benefit from technological enrichment demonstrate high levels of frustration when the technology malfunctions [29]. Thus, while there is evidence that providing enrichment is essential for the mental well-being of animals living under human care, it is equally important to consider the effect that discontinuation of access to enrichment may have on the animals' welfare. Moreover, it seems plausible that the greater the benefit of the enrichment, the greater the significance of the loss when the apparatus that delivered the enrichment is removed and, thus, the greater the risk that removal may cause frustration and lead to the development of stereotypies. That is, the removal of an apparatus that was not particularly enriching might cause little or no frustration, while the removal of an apparatus that provided significant enrichment might cause great distress to the animal. This has implications for ACI researchers who aim to design technologies for enrichment and who work with animal participants to develop or evaluate prototypes.

## 2.3 Enrichment Provision vs Research Needs

Researchers have an ethical responsibility to ensure that their interventions are not misused and consequently cause harm [5]. Thus, during the course of an experiment, use of stimuli is usually supervised and, when the study concludes, the apparatus is often removed. At this point, participants lose access to the intervention. In clinical research, removing access to interventions is called 'de-adoption'. De-adoption may include de-prescribing, abandoning, or de-implementing an intervention [23]. De-prescribing may occur if an intervention appears to have a negative impact on animal subjects, and researchers discontinue it to prevent further harm. Abandoning an intervention means that animals lose access to its benefits; for example, if, following a study that afforded subjects to engage in conspecific-social interactions, caregivers are not encouraged to enable the animals to continue using the applications that facilitated those interactions [10]. De-implementation involves the removal of apparati and resources that would allow animal subjects to continue to access the intervention; for example, they may lose access to games, if the applications that provide those games are technically unsupported beyond the duration of a study [10].

Even in the case of studies that provide highly beneficial enrichment for animal participants, upon conclusion of the research interventions may need to be de-implemented or abandoned. Besides, some research apparati may be expensive to maintain in terms of either time or money, or may be needed elsewhere for other studies. Additionally, researchers may be legally liable for averse impacts that may occur outside of their supervision, if participants continue to have access to devices. In other words, there are practical, welfare and legal considerations that may warrant removing research interventions at the conclusion of a project. Thus, there is a tension between: on the one hand, animals' potential need for continued access to enriching interventions that may benefit their welfare, and reduce the risk of stereotypies, particularly if animals habitually live in impoverished environments; and, on the other hand, researchers' need to reallocate resources, ensure animals' safety, and limit legal their own liability. This raises the question as to how ACI researchers might deal with this tension when they design their research. Here we present a case study, exemplifying the responses of a Goffin's cockatoo who participated in an experiment aiming to understand the enriching potential of video-calling applications that allowed parrots to remotely interact with conspecifics, and who subsequently lost the ability to do so, until she was afforded that again, many months later. We discuss how the cockatoo responded to the post-study loss of enrichment and how, in turn, researchers responded to the cockatoo by progressively reinstating the bird's access to the same kind of enrichment. Subsequently, we exemplify different research scenarios and how researchers might handle de-adoption.

# 3 Case study

## 3.1 Subject

The subject was an 11-year-old enculturated Goffin's cockatoo, Ellie, who was acquired by her caregiver at 14 weeks of age. She is housed with two other cockatoos in a 7.3 x 7.3m indoor aviary with access to an outdoor aviary of roughly the same size. For enrichment, Ellie is provided with a variety of naturalistic play and foraging items. She has constant access to food and pellets.

## 3.2 Video Call Methods

During various phases of the time period, Ellie could video call. On a tablet device she could access two different applications: a messenger caller application and a speech board application. Through the messenger it was possible to access a gallery of pictures, portraying individual parrots participating in the experiment, from which she could select the bird she wanted to call by touching the picture with her beak. However, the messenger application was not easy for her to access, so her caregiver would normally need to open it for her before she could make a selection and initiate a call. The speech board application was a lot easier for her to access and she habitually used it to indicate things she wanted by navigating and selecting from menus of items (e.g. pictures, drawings). The speech board also featured a menu of pictures portraying individual parrots participating in the experiment, which she could use to make a call request by selecting the wanted callee, at which point the caregiver would open the messenger application for her. In some instances, Ellie navigated out of other apps and opened the messenger app to select and video call other parrots.

## 3.3 Enrichment Provision: Four Phases

*3.3.1 Phase 1: December 2021-February 2022.* During the initial experiment, Ellie was afforded 'meet and greet' video calls to other birds four times per week for two weeks. After that, as Ellie requested on the speech board device, caregivers tried to coordinate additional video calls.

*3.3.2 Phase 2: March 2022-April 2023.* During a subsequent period, when Ellie had again access to the same device,she could continue to make requests to video-call other parrots by selecting their picture on her speech board application. However, during this time, the frequency with which she was able to call dropped significantly, because her caregiver no longer had the time to give her the same level of access to the video-calling application and because other birds were no longer as available as they had been during the experiment (since, in turn, their caregivers no longer had the time to give them the same level of access). In September, 2022, the caregiver removed the the pictures of the other parrots from the speech board, until May, 2023. However, several months later, at the

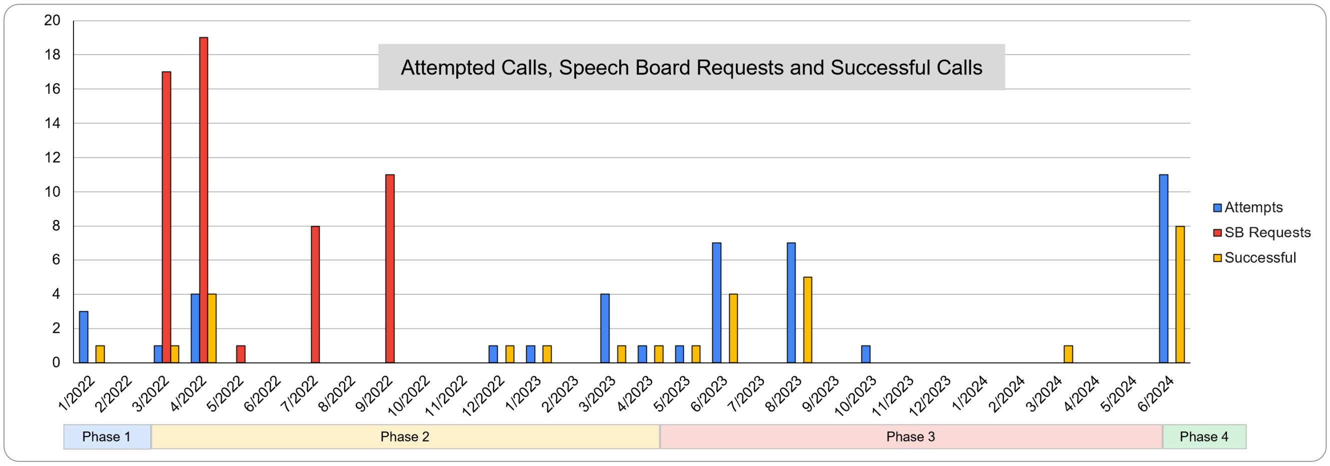


**Figure 1: The parrot's logged attempted calls, speech board requests and successful calls over the course of 31 months. Phase 1 comprised the parrot's participation in a pilot study. Phase 2 comprised a period of time when the parrot was generally unable to successfully call other parrot callees. In phase 3, the caregiver began leaving the video messenger app available for the parrot's use, but the device seemed difficult to utilize, and it was taken away again. In phase 4, the caregiver allowed the parrot to request a callee and then set up the messenger app so the parrot could call the selected callee while the caregiver was absent from the room. (Note: speech board requests were only logged March-September, 2022.)**

end of phase 2 (in March, 2023) Ellie somehow managed to locate and open the messenger application, and successfully initiated video calls to the other parrots–none of which were answered by the callees. After that, the caregiver added the bird pictures back to the speech board, but then went out of town.

*3.3.3 Phase 3: May 2023-May 2023.* The caregiver began frequently leaving the messenger application open onto a menu comprising pictures of human and bird callees when she left Ellie's room, which allowed the bird to make video calls independently. As mentioned above, the messenger device, however, posed some usability challenges: to initiate a video call, Ellie needed to select a callee; the device then opened onto the callee's chat screen and the parrot would need to press (sometimes several times, because not every press was registered by the device) on a button to call-through. To reduce the effort required to trigger the calls, from October 2023 to June 2024, the caregiver left the messenger open onto her own chat screen to allow Ellie to only call her. Nevertheless, during this time period, Ellie also occasionally managed to navigate to the chat screen of other birds (whether by navigating out of the speech board or out of the caregiver's messenger chat screen) and initiate video calls (none of which were answered by the callees).

*3.3.4 Phase 4: June 2024-July 2024.* The caregiver created a speech board menu that allowed Ellie to select a human or bird callee. Ellie would then select the individual she wanted to video call; her caregiver would contact the selected individual (if this was a human) or their caregiver (if the selected individual was a bird) to confirm their availability; Ellie's caregiver would then open the messenger application onto the chat screen of the selected callee, so Ellie could initiate a video call to them when her caregiver was out of the room. Although this solution afforded Ellie the ability to make successful video calls, Internet connectivity was a complication in this phase. Additionally, the parrot developed an infection that disrupted her calling activity, with illness and treatment spanning 4 weeks (June 27-July 25). Nevertheless, accounting for a 4-week duration during this time, we logged the frequency and successful call-through rates of the parrot's calls.

## 3.4 Data Collection and Analysis

Data from the three phases described above was collected by reviewing the tablet Messenger calling logs for the call dates and reviewing caregiver notes and messages to identify the call trigger. Speech board selection data were also analyzed. During these periods, every selection for "bird friend" was logged, including the date, the manner with which calls were requested or initiated, the bird callee requested, whether Ellie was able to connect with the requested bird and, if so, duration of the call. Over a period of 31 months (from December 2021 to July 2024 included), we analyzed all of Ellie's speech board selections for bird callees during Phase 1 and Phase 2 (December, 2021-September, 2022) as well as messenger app selections and independently-initiated video calls to other bird callees during Phases 2, 3 and 4. These are summarized in Figure 1.

## 3.5 Research Ethics

Because the cockatoo is a companion animal living with her caregiver, ethical approval requirements were waived by the primary academic institutions involved in the research. However, at all stages, the research protocol and the caregiver's engagement with the bird was consistent with the principles of relevance, impartiality, welfare and consent (both mediated and contingent) underpinning the animal-centred research and design frameworks previously proposed for ACI research [16].

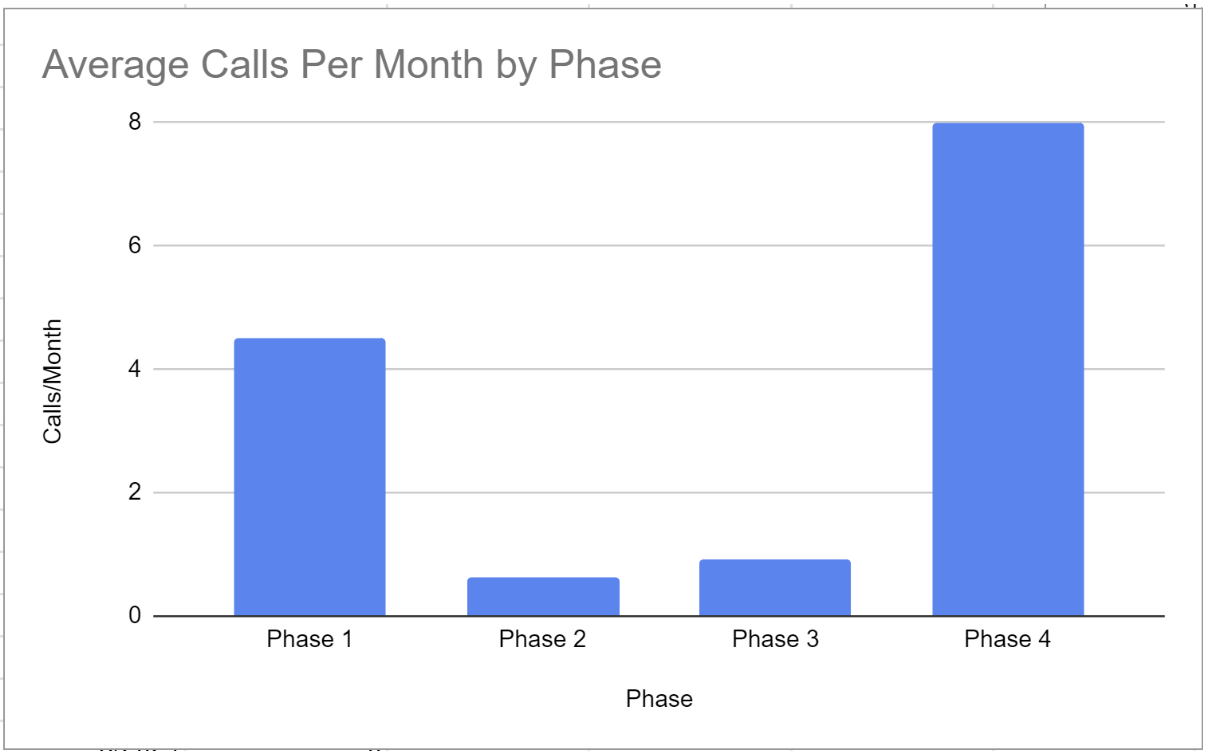


**Figure 2: During the pilot study, the parrot had regular access to other parrot callees as caregivers coordinated their schedules when the parrots selected to call another bird. In phase 2, the parrot's successful call rate declined due to caregiver coordination challenges. In phase 3, a calling device was available to the parrot, but it seemed too difficult to use. During phase 4, the caregiver allowed the parrot to select a callee (parrot or human) from a speech board device and then left a messenger app available and open to the callee parrot button for the parrot to call if it so chose.**

## 3.6 Findings

*3.6.1 Calls During Phase 1.* During this phase, when the initial experiment took place, Ellie was afforded 8 meet-and-greet video calls that were coordinated by the caregivers. After that, Ellie selected to video call another parrot 3 times, and was only able to connect 1 time (33%). (A the other end, the other parrot attempted to video call an additional 3 times, and was successful 2 times, 67%).

*3.6.2 Calls during phase 2.* During this phase Ellie continued to express the intention to call other birds but most of the times she was unable to do so. She made repeated requests via her speech board, suggesting a persistent desire to make the calls, before her requests started to diminish in frequency. Ellie selected bird friend pictures on her speech board 56 times across 13 different days within a time span of six months. 35 (64%) of the selections occurred within the 8 weeks following the initial experiment. (Figure 2 shows the rate at which the call requests occurred and extinguished.) Overall, 48 (85%) of Ellie's bird friend selections were refused, but on 2 of the 13 days she was able to remotely interact with the selected bird friend (and one of those days included two interactions). Ellie continued to make requests via her speech board, until the caregiver removed the bird friend pictures from the speech board in September 2022. However, in March 2023 she opened the video calling application to the chat screen of Cookie, a bird callee who had taken part in the initial experiment, which prompted the caregiver to set up the device so Ellie could video call other birds and people.

*3.6.3 Calls during phase 3.* During this phase, Ellie attempted to make 16 video calls to other birds across 9 different days, 11 (63%) of which were successful. After the caregiver set up the messenger application to only allow Ellie to call her in October 2023, Ellie independently opened the messenger app onto the chat screen of bird callees and made 4 calls in January 2023 and 2 calls in March 2023, only 1 (17%) of which were successful.

*3.6.4 Calls during phase 4.* During this phase, facilitated by the caregiver's new arrangement, Ellie made 11 video calls across 5 days, 8 (73%) of which were successful. Figure 2 illustrates the average number of calls per month in each phase.

# 4 Reflection

## 4.1 Enrichment Provision and Ethical Principles

Data from the above case study suggests that the ability to make video calls to other birds had enriching value for the cockatoo. With her caregiver's facilitation, she was able to make calls to other birds during phase 1, all of which she had to request. In phase 2, when her ability to make calls was curtailed by circumstance, she continued to request them, insistently to begin with, until gradually her requests extinguished over a period of time. In phase 3, when Ellie was given the option of making independent calls to human or bird callees, she attempted the calls despite the usability challenges she encountered and was successful most of the times. Finally, in phase 4, when the caregiver's facilitation and coordination with callees gave her easier access as well as choice, Ellie continued to make calls, and with a seemingly higher success rate. Arguably, once the cockatoo's agency was enabled by giving her choice and a (mediated) way of controlling the video-calling application, the benefit of the enrichment intervention was finally regained after being temporarily lost.

More generally, this example highlights considerations regarding the provision of enrichment during research projects and the loss that may be experienced by the animals as a result of subsequently taking away the enrichment previously provided. Consistent with the ethical principles discussed above (relevance, impartiality, welfare and consent [16]), and assuming that all animals participating in ACI research are treated with impartiality, we suggest that important considerations could include:

- the extent to which the enrichment is biologically relevant to the animal and, thus, likely to be meaningful for them
- the extent to which the enrichment enhances the animal's welfare, by fulfilling species-specific welfare priorities
- the extent to which the animal is enabled to provide contingent consent to engaging with the enrichment, including whether they are in control of the choice to engage or not engage

In the cockatoo's case, the ability to video-call other parrots had biological relevance, as discussed in previous work [10]. Parrots are highly social animals and can benefit from social interactions with conspecifics, but in domestic settings they are usually housed singularly, which creates a welfare deficit. However, they are also territorial animals and physically encountering parrots with whom they are not paired can lead to aggression, resulting in negative welfare impacts. Thus, given the settings in which many of these animals live, the ability to meet remotely can fulfil a biological function that would otherwise be difficult to fulfil. Consequently, this form of enrichment is likely to have enhanced the cockatoo's welfare. Concomitantly with her positive behavioural signs during these remote interactions [10], her motivation to continue calling, suggests that the activity had welfare value for her; and, once she was given again easy access to the video-calling application and a number of prospective callees, the welfare value was further increased by the fact that she was given agency over its access. Lastly, her continuing requests to make video-calls, during phases 1 and 2, and her continuing autonomous calls, during phases 3 and 4, suggest a high degree of contingent consent to participating in video-calling activities.

The fact that, in phase 2, the cockatoo continued to request to make video calls to other birds and that most of these requests were unfulfilled, suggest that she experienced a loss of a biologically relevant activity that had enhanced her welfare and that she had wanted to engage in (although, of course, we cannot precisely assess the extent of the loss). Fortunately, it was eventually possible for her caregiver to give her access and control over the application. However, as discussed above, this is not always the case in research projects and animals usually lose access to the enrichment they had been provided during the research. In this regard, we envisage different possible scenarios, three of which we consider to illustrate possible ethical and practical implications.

## 4.2 Ethical and Practical Implications

*4.2.1 Assessing the Implications of Enrichment Withdrawal.* As mentioned earlier, it is plausible that the greater the benefit of enrichment, the greater the loss when this is removed. In this regard, different scenarios are likely to require different exit strategies to manage the end of a project in way that minimises impacts on research participants. For example, Zamansky et al. [32] conducted a study examining videos of dogs interacting with on-screen games that featured moving objects. These consistently elicited hunting behavior patterns and the authors warn that for many dogs the interactions were overstimulating, frustrating and stressful, with videos showing some of them frantically pawing at the screen, pouncing on and even biting the displaying device. In this case, while an interaction aimed at enriching the dogs' experience might have had biological relevance, it seemed to negatively impact their welfare, while their contingent consent could not necessarily be assumed, since their frantic behaviour seemed compulsive. In cases like this, de-prescription would seem appropriate: withdrawing the intervention at the earliest opportunity might be beneficial and even necessary, although researchers might need to consider whether to do so abruptly or gradually, depending on the potential risks of sudden withdrawal.

For another example, Hirskyj-Douglas et al. [8] developed an apparatus that allowed dogs to watch different kinds of audiovisual content on TV, to understand their propensity to do so and their content preferences. The dog participating in the study was in control and free to engage or disengage at any time. The authors found that he was mostly uninterested in watching videos, although he had a moderate preference for videos of dogs. In this case, the intervention seemed to be of limited biological relevance for the dog and of no consequence for his welfare, while the experimental set-up gave him full control, which allowed him to exert his agency by disengaging from the experience at will. In cases like this, de-implementation would not seem pose any risks: withdrawing the intervention would likely have little effect for the animal and could be done by simply discontinuing its use.

For yet another example, Wallis et al. [28] developed an on-screen game to provide cognitive stimulation for aging dogs, which featured simple abstract shapes appearing randomly on a screen for the dogs to 'catch' by touching them with their snout. The researchers used positive reinforcement to help the dogs associate the touching of the shapes with the automatic delivery of food treats by a dispenser located underneath the screen. They observed a very positive response from their canine participants, in the form of keen engagement, positive demeanor and progressive proficiency. In this case, the activity seemed to have considerable relevance for the dogs and a positive effect on their welfare, and the dogs seemed to consent to participating in the activity by their keen engagement. It is in cases like this that abandonement might warrant careful consideration: withdrawing the intervention might require a transition strategy, whether this involved modifying an application to safely

**Table 1: Simple assessment, against basic ethical principles, of the potential need to implement an exit strategy upon de-adoption of a research intervention in example scenarios, drawn respectively from Zamansky et al. 2017 (example 1), Hirskyj-Douglas et al. 2017 (example 2) and Wallis et al. 2017 (example 3).**

| Simple Assessment Table | | | |
|---|---|---|---|
| | **EXAMPLE 1** | **EXAMPLE 2** | **EXAMPLE 3** |
| | Dog given tablet displaying non-responsive objects shooting across screen | Dog given opportunity to watch a wide range of different videos on screen | Dog given interactive app displaying shapes randomly appearing on screen and disappearing when touched, prompting delivery of food treat |
| **PRINCIPLES** | | | |
| Relevance | High relevance as tablet display stimulates dog's chase drive; but doubtful benefit as display lacks other sensory stimuli and is not interactive | Unclear relevance e.g. since videos lack olfactory and tactile stimuli, and are not responsive; possible but unclear benefit as entertainment | High relevance as dog learns to that catching the shapes delivers food and display motivates chase drive; benefit to cognitive process of attention |
| Impartiality | Dog treated by researchers with consideration given to humans | Dog treated by researchers with consideration given to humans | Dog treated by researchers with consideration given to humans |
| Welfare | Dog presents signs of high arousal and frustration as hyperactive but non-functional interaction with tablet, so welfare is likely reduced | Dog appears comfortable and seems to pay attention to some of the videos, the interaction seems to have little impact on his welfare one way or the other | Dog appears comfortable and actively engaged, and both his demeanour and interaction logs indicate a positive effect on his welfare |
| Contingent consent | Dog provides contingent consent to participate by engaging in the interaction but does not attain homeostatic release, so engagement is frantic | Dog is free to engage with or disengage from video as well as experiment, occasionally turning or moving away | Dog is coached by researcher but is free to engage with or withdraw from the interaction, and chooses to engage |
| **EXAMPLE CONSIDERATIONS ON POTENTIAL NEED FOR EXIT STRATEGIES** | | | |
| | Enrichment is potentially detrimental to the dog's welfare; he may be having a strong innate response to the stimuli of which he is not in control, so contingent consent is questionable. Withdrawal of the technology at the earliest opportunity is likely appropriate, to avoid further negative welfare impact. Exit strategy other than discontinuation may not be needed or even appropriate. | Enrichment does not seem to be detrimental nor particularly beneficial for the dog's welfare; he responds to the stimuli by paying more or less attention to them depending on the video's content, but his interest seems to be limited. Withdrawal is unlikely to affect his welfare one way or another. Exist strategy is likely not required nor relevant. | Enrichment seems to be beneficial to the dog's welfare; he responds positively with focussed attention and keen interaction, as evidenced by his behaviour and interaction logs. Withdrawal may negatively affect his welfare, so may need to be done with care. Exit strategy may help mitigate the potentially negative effects of discontinuation. |

afford the animal continued access to the enrichment beyond the end of a project (and with our case study), or gradually reducing the frequency with which the animal could access the enrichment to facilitate a stress-free extinction process. Table 1 summarises the different example scenarios.

4.2.2 *Ethical Review and End-of-Project Impact Assessment.* Whatever the expected relevance and benefit for participating animals of a proposed research activity, we suggest that plans for an appropriate exit or transition strategy at the end of an ACI project could form part of the information that researchers submit to their ethical review bodies when seeking institutional research ethical approval. In this regard, an enrichment intervention's expected biological relevance, welfare benefits and scope for consent could be assessed to estimate the potential risk of negative impacts resulting from the intervention's withdrawal at the end of the research. This kind of risk assessment could inform a withdrawal strategy that could become integral part of an ethics approval application. Similarly, when reporting on ACI research, for example through scientific publications, authors could report on how they assessed the potential risks of withdrawing planned interventions and what provisions they made to mitigate those. In brief, we suggest that, for the purposes of conducting animal-centred research and design, considering the effects of withdrawing interventions once the research has concluded is as important as considering the effects of interventions during the research.

## 5 Conclusion

Enhancing animals' lives through research that offers enrichment components may bring quality of life improvements that require ethical consideration for when research projects come to an end. This is especially important when an intervention provides biologically meaningful enrichment. Thus, when considering research design, it may be necessary to plan for the gradual removal or the long-term continuation of the intervention. Along with an illustrative case study exemplifying the experience of a Goffin's cockatoo with an application allowing her to video call other parrots, we have proposed a simple approach to assess, against the ethical principles of relevance, welfare and consent, whether an exit strategy might be necessary and what this might need to be in different scenarios.

## References


[1] 1938. Food, Drug, and Cosmetic Act. Public Law 75-717, 52 Stat. 1040.

[2] EUs Directive. 2010. 63/EU of the European Parliament and of the Council of 22 September 2010 on the protection of animals used for scientific purposes. Off. J. Eur. Union 276 (2010), 33–79.

[3] Yiru Dong. 2019. Injurious pecking behavior of Pekin ducks on commercial farms: characteristics, development and duck welfare. Master's thesis. Purdue University.

[4] Larry Freil, Ceara Ann Byrne, Giancarlo Valentin, Clint Zeagler, David L. Roberts, Thad Starner, and Melody Moore Jackson. 2017. Canine-Centered Computing. Found. Trends Hum. Comput. Interact. 10 (2017), 87–164. https://api.semanticscholar.org/CorpusID:207178617

[5] DW Gotterbarn, Bo Brinkman, Catherine Flick, Michael S Kirkpatrick, Keith Miller, Kate Vazansky, and Marty J Wolf. 2018. ACM code of ethics and professional conduct. (2018).

[6] Alexandra N Gross, S Helene Richter, A Katarina J Engel, and Hanno Würbel. 2012. Cage-induced stereotypies, perseveration and the effects of environmental enrichment in laboratory mice. Behavioural Brain Research 234, 1 (2012), 61–68.

[7] I Hirskyj-Douglas and JC Read. 2016. The ethics of how to work with dogs in animal computer interaction. In Proceedings of the Animal Computer Interaction Symposium. Measuring Behaviour.

[8] Ilyena Hirskyj-Douglas, Janet C Read, and Brendan Cassidy. 2017. A dog centred approach to the analysis of dogs' interactions with media on TV screens. International Journal of Human-Computer Studies 98 (2017), 208–220.

[9] Ronald R Keiper. 1969. Causal factors of stereotypies in caged birds. Animal Behaviour 17 (1969), 114–119.

[10] Rebecca Kleinberger, Jennifer Cunha, Megha M Vemuri, and Ilyena Hirskyj-Douglas. 2023. Birds of a Feather Video-Flock Together: Design and Evaluation of an Agency-Based Parrot-to-Parrot Video-Calling System for Interspecies Ethical Enrichment. In Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems. 1–16.

[11] Kathy Laber, Christian E Newcomer, Thierry Decelle, Jeffrey I Everitt, Javier Guillen, and Aurora Brønstad. 2016. Recommendations for addressing harm–benefit analysis and implementation in ethical evaluation–report from the AALAS–FELASA working group on harm–benefit analysis–part 2. Laboratory animals 50, 1_suppl (2016), 21–42.

[12] Naomi Latham and Georgia Mason. 2010. Frustration and perseveration in stereotypic captive animals: is a taste of enrichment worse than none at all? Behavioural Brain Research 211, 1 (2010), 96–104.

[13] Clara Mancini. 2011. Animal-computer interaction: a manifesto. interactions 18, 4 (2011), 69–73.

[14] Clara Mancini. 2017. Towards an animal-centred ethics for Animal–Computer Interaction. International Journal of Human-Computer Studies 98 (2017), 221–233.

[15] Clara Mancini, Orit Hirsch-Matsioulas, and Daniel Metcalfe. 2023. Politicising Animal-Computer Interaction: an Approach to Political Engagement with Animal-Centred Design. In Proceedings of the Ninth International Conference on Animal-Computer Interaction (Newcastle-upon-Tyne, United Kingdom) (ACI '22). Association for Computing Machinery, New York, NY, USA, Article 1, 11 pages. https://doi.org/10.1145/3565995.3566034

[16] Clara Mancini and Eleanora Nannoni. 2022. Relevance, Impartiality, Welfare and Consent: Principles of an Animal-Centered Research Ethics. Frontiers in Psychology 3 (2022), 694719.

[17] Christopher Flynn Martin and Robert W Shumaker. 2018. Computer tasks for great apes promote functional naturalism in a zoo setting. In Proceedings of the Fifth International Conference on Animal-Computer Interaction. 1–5.

[18] Georgia J Mason. 1991. Stereotypies and suffering. Behavioural processes 25, 2-3 (1991), 103–115.

[19] Eleonora Nannoni and Clara Mancini. 2024. Toward an integrated ethical review process: an animal-centered research framework for the refinement of research procedures. Frontiers in Veterinary Science 11 (2024), 1343735.

[20] Luisa Ruge and Clara Mancini. 2022. An Ethics Toolkit to Support Animal-Centered Research and Design. Frontiers in Veterinary Science 9 (2022), 891493.

[21] J Rushen. 1984. Stereotyped behaviour, adjunctive drinking and the feeding periods of tethered sows. Animal Behaviour 32, 4 (1984), 1059–1067.

[22] William Moy Stratton Russell, Rex Leonard Burch, Charles Westley Hume, *et al.* 1959. The principles of humane experimental technique. Vol. 238. Methuen London.

[23] Alvaro Sanchez, Jose Ignacio Pijoan, Susana Pablo, Marta Mediavilla, Rita Sainz de Rozas, Itxasne Lekue, Susana Gonzalez-Larragan, Gaspar Lantaron, Jon Argote, Arturo García-Álvarez, *et al.* 2020. Addressing low-value pharmacological prescribing in primary prevention of CVD through a structured evidence-based and theory-informed process for the design and testing of de-implementation strategies: the DE-imFAR study. Implementation Science 15 (2020), 1–11.

[24] Heli K. Väätäjä and Emilia K. Pesonen. 2013. Ethical issues and guidelines when conducting HCI studies with animals. In CHI '13 Extended Abstracts on Human Factors in Computing Systems (Paris, France) (CHI EA '13). Association for Computing Machinery, New York, NY, USA, 2159–2168. https://doi.org/10.1145/2468356.2468736

[25] Heli K Väätäjä and Emilia K Pesonen. 2013. Ethical issues and guidelines when conducting HCI studies with animals. In CHI'13 Extended Abstracts on Human Factors in Computing Systems. ACM, 2159–2168.

[26] Dirk van der Linden. 2023. Animal-centered design needs dignity: a critical essay on ACI's core concept. In Proceedings of the Ninth International Conference on Animal-Computer Interaction (Newcastle-upon-Tyne, United Kingdom) (ACI '22). Association for Computing Machinery, New York, NY, USA, Article 2, 7 pages. https://doi.org/10.1145/3565995.3566028

[27] JS Veasey. 2017. Identifying design priorities for optimal welfare. In Proceedings of the International Zoo Design Conference, Wroclaw, Poland. 4–7.

[28] Lisa J Wallis, Friederike Range, Enikő Kubinyi, Durga Chapagain, Jessica Serra, and Ludwig Huber. 2017. Utilising dog-computer interactions to provide mental stimulation in dogs especially during ageing. In Proceedings of the Fourth International Conference on Animal-Computer Interaction. 1–12.

[29] David A Washburn. 2015. The four Cs of psychological wellbeing: Lessons from three decades of computer-based environmental enrichment. Animal Behavior and Cognition 2, 3 (2015), 218–232.

[30] Michelle Westerlaken and Stefano Gualeni. 2016. Becoming with: towards the inclusion of animals as participants in design processes. In Proceedings of the Third International Conference on Animal-Computer Interaction. 1–10.

[31] Christoph Wiedenmayer. 1997. Causation of the ontogenetic development of stereotypic digging in gerbils. Animal Behaviour 53, 3 (1997), 461–470.

[32] Anna Zamansky, Dirk van der Linden, Sofya Baskin, and Vitaliya Kononova. 2017. Is My Dog" Playing" Tablet Games? Exploring Human Perceptions of Dog-Tablet Interactions. In Proceedings of the Annual Symposium on Computer-Human Interaction in Play. 477–484.