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ABSTRACT

This article presents an empirical reflection on how the prototyping of an environmental enrichment device for chimpanzees at the National Zoo of Chile precipitates a cosmopolitical encounter. Using material produced by design students, zookeepers and the chimps Judy and Gombe, we describe how prototyping iterations establish open processes of dialogue and encounters among humans and nonhumans. The case will demonstrate how prototyping can go further than the generation of models of an original. On the contrary, the cosmopolitical encounter emerging from the prototyping process makes evident a truly ontological vocation, acknowledging humans and other-than-human beings as singular entities. Its provisional and malleable nature turns this device into a privileged *locus* for the exploration of interspecies entanglement. Although zoos are scientifically organized institutions, in this case we observe how its anthropocentric hierarchy was performatively reshuffled at certain moments of the prototyping process. The cosmopolitical qualities of the prototyping process analyzed derive from its capacity to deploy an ethics of attention and care between the agencies at play, that is, for unfold gestures of mutual vulnerability. Finally, we propose prototyping as a device for moving from cosmopolitics as a way of understanding the world to cosmopolitics as a *matter of design*.

Introduction

> As Donna Haraway emphasized (…), the sixth day of creation as told in Genesis 1:24–31 is also a story about human exceptionalism. During the same day God created not only Adam and Eve, in his own image, but also beasts of the earth according (…) to a kind that prepares them for use and classification by Adam and Eve. (Stengers 2010)

The exterior of the enclosure where the four lions live (Figure 1) at the National Zoo in Santiago, Chile (NZSCH) was chosen as a design subject by one of the fifteen teams of design students from the Interaction Design Workshop at the Pontificia Universidad Católica de Chile (IDW). The group of design students named 3Cata+1 created an information board about the lions to engage visitors at the NZSCH. During the research phase, zookeepers[1] were interviewed by the design team about their relationship with the lions to arrive at a better understanding of these animals. The interviews gave the designers insight into the biographies and personalities of the four lions – one male and three females. They learned that the male, *Manolo*, and the female, *Dueña de Casa*, were born at NZSCH in 1998. According to the zookeepers, this is why these two lions were dominant and more reluctant to interact with visitors and staff. The other two lions, *La Flaca* and *La Gorda*, were

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Figure 1. Lions at the National Zoo of Chile (3CATA+1 2014).

rehomed to NZSCH after they were abandoned by a circus in a state of malnutrition. These circumstances and the conditions in which they had been kept at the circus helped to explain their more active behavior, their acceptance of *Dueña de Casa* as the dominant female, and their willingness to interact with people near their enclosure.

By including anecdotes from the zookeepers about the lions' biographies and personalities, the designers could give the information boards a narrative voice. Each member of the quartet was described in a brief biography and personality profile, characterizing them as subjects in the hope that visitors would feel more empathy towards them. When trialed *in situ*, the resulting prototype 'turned the lions into a topic of conversation and led to a three-fold increase in the amount of time visitors spent in front of the enclosure' (3Cata+1 2014). However, there was controversy when the team unveiled their representation of the lions to zoologists, vets, and other scientists working at NZSCH, who argued that if the information board were to be installed permanently in the zoo, the four felines must be represented as examples of their species. In other words, the four lions should be presented as an African pride and not as four roommates. This controversy revealed two different approaches to representing the lions, one associated with the idea of human exceptionalism – lions as a species – and one that singularized them as anthropomorphic subjects.

This controversy raises several questions: What kind of encounters precipitate the prototype between the entities that interact? What is the role of prototyping in the singularization of non-human beings? Finally, how can environments and spaces that incorporate the differences and recalcitrance of the human and non-human entities that inhabit them be co-designed?

Based on the observation of three successive iterations of prototyping aimed at designing and implementing an environmental enrichment device for Judy and Gombe – the chimpanzees at the NZSCH[2] – we describe how cosmopolitical encounters (Hermansen and Tironi 2018) between human and non-human emerge in certain moments of this prototyping, contributing to a singularization process and creating a space for interspecies intimacy. As a sort of cosmopolitical diplomacy device (Stengers 2005, Latour 2007), these prototyping events establish open processes of mutual exploration between the various ontologies involved, launching knowledge creation through empirical means and making visible, arguable, and tangible matters related to the actors' recalcitrance.

Our intention is to show how the inherently provisional and fragile nature of prototyping helps us to avoid pre-established values or concepts. We demonstrate how this prototyping process precipitates the emergence of unexpected relationships and agencies. In this way, the recalcitrant behavior of Judy and Gombe during the prototyping event obstructed the exercise of prescriptive design – and inspired problem-solving and user-centered design. During the observed prototyping iterations, Judy and Gombe resist being defined as members of a kind and push to be recognized as individuals. In fact, at some points of the prototyping process, they subvert and modify the prototype, becoming non-human co-designers. In this way, the paper shows the potential of prototyping to unfold (Rubio and Fogué 2017) recalcitrant singularities and materialize cosmopolitical encounters (Ehn 2017).

This article is divided into four parts. First, we present a historical overview of zoological institutions and analyze some of the changes in the keeping, representation, and categorizing of zoo animals. Second, we describe the epistemological challenges associated with the practice of prototyping cosmopolitical encounters (Hermansen and Tironi 2018). The third part describes three prototyping iterations aimed at designing an environmental enrichment device for Judy and Gombe (Figure 2). In the concluding section, we closely analyze this case as an example of the potential for prototyping to materialize cosmopolitics and reflect on its effects on the epistemological and methodological aspects of design practice. We hold that it is not just an environmental enrichment device that is being prototyped here, but the very concept of cosmopolitics. We suggest that by moving from cosmopolitics as an analytical perspective towards prototyping as a cosmopolitical event, we expand its scope, transforming this notion from a matter of concern into a matter of design.

From local zoo to global network of parks for animal welfare

The origins of zoological parks and their evolution are closely linked to the views of the communities and institutions to which they belong. During the second half of the nineteenth century in Europe, the general understanding of zoological parks evolved from places for exhibiting captured animals to healthy environments that counteracted increasing industrial pollution. Zoos offered cities prestige and served as environments for animal domestication in addition to educating citizens, 'engaging in (theoretical) classification and (practical) acclimatization' (Lambrechts 2014, p. i).

Chile's National Zoo followed these trends. It opened in 1925, fifteen years after the country's centennial, on a 4.8 hectare (9.9 acre) site on San Cristobal Hill close to downtown Santiago. Its Victorian design presents animals as captive specimens. The return to democracy in Chile (1989) heralded a new era for humans as well as zoo animals. After more than six decades without undergoing major changes, the NZSCH began to adopt international animal welfare standards. Principles such as environmental enrichment were applied systematically, improving exhibition standards and the animals' physical and psychological life conditions. Conservation research has transformed the NZSCH into a multifaceted institution with links to major international networks (MINVU 2014). These connections have brought about changes to animal biographies and record-keeping. Although some exotic specimens have been rehomed to NZSCH after being confiscated – because they

Figure 2. Judy and Gombe at the NZSCH (Chimpáticos 2014a).

were illegally imported, mistreated or abandoned – most of NZSCH's animals were born within the park or at other network zoos (Cubillos 2014).

From the first collections of exotic animals – captured and put on display to show the extension of imperial power and military force – to the modern-day parks for animal welfare, zoos have developed differently and the roles of zoo' animals have changed. They have served as trophies, representations of the exotic and savage, scientific specimens, and, more recently, as survivors of 'Progress' that need to be understood and preserved, as their original habitats are in danger. These evolutions in the modes of representation have been typified as the slow and gradual substitution of an anthropocentric view for the idea that animals begin to be valued as sentient beings whose suffering cannot be justified (Singer 1975). Signs from the early twentieth century that warned: 'Caution! Dangerous animals, do not enter!' have been replaced by plaques that read: 'Please respect the animals' need for a calm environment and refrain from striking the fence.'

For animals in today's international zoo networks, the zoos are their native environment, just as cities are to their denizens. The zoo's role is not only to exhibit animals as samples of wilderness: these ecologies designed by humans serve as conservation and reproduction laboratories. Most of the animals that now inhabit any zoo of relative complexity are descendants of animals raised within a zoo: neither Taco – the polar bear settled in Santiago but born in the Netherlands – nor his parents, nor his brother, had ever been to the North Pole. They do not know the cold and they do not eat like

a polar bear in its original environment. They are inhabitants of an international circuit and partici-pate in an urban ecosystem. They share the routines of those who take care of them; they take medi-cine and eat industrial foods; they are subjects with rights and obligations.

Furthermore, as some STS researchers have stated, advances in science and technology transform society into an experimental space that blurs the boundaries between the 'confined laboratory' and the 'outdoor laboratory' (Callon et al. 2001), evoking the crisis around the idea of a given world (*out there*) and the traditional separation between nature and culture (Kohn 2007, Latour 2008). Quoting Latour (2008, p. 9), this implies 'the slow and painful realization that there is no outside anymore. It means that none of the elements necessary to support life can be taken for granted.' Like the weather, the Internet, viruses, tourism, rivers, and other global phenomena, animals are social and political matters of concern (Latour 2004).

The grammar of prototyping

The question of how plausible information about ontologically diverse informants–recipients can be produced is linked to the problem of experimentation devices that make reality speak. This problem regarding the role of materialities in the enactment of certain realities has been at the center of tra-ditions of anthropology and the sociology of science (Hacking 1983, Latour and Woolgar 1988) and, more recently, in design anthropology.

The work of Shapin and Schaffer (1993) on the controversies between Boyle and Hobbes over the vacuum pump is a key reference for tracking the origins of the notion of experimentation. The origin of this notion provides key insights into the experimental dimension of the prototyping process. The authors suggest that Boyle's experimental infrastructure is based on three types of technology: material (equipment and support), textual (narration to restore the discovered scientific facts) and social (a community that witnessed the demonstrations). The material technology used by Boyle marked a turning point in the modes of representation of nature: scientists must test and visualize concepts and hypotheses through experimental devices (Latour 1997, Daston and Galison 2012, Corsín Jiménez 2013).

Contemporary ethnographic studies of experimental practices (Latour and Woolgar 1988, Lynch and Woolgar 1990) reveal two key aspects that help us think about the grammar of experimentation and, by extension, that of prototyping. First, materiality reshapes a reality that wants to be known or represented. Recognizing the multiplicity of the inscription devices (Latour and Woolgar 1988) allows us to materialize scientific knowledge and understand that notions as 'truth,' 'natural,' or 'irrational' do not pre-date laboratory work (Latour 1984), which weaves together cognitive, material, and narrative technologies, creating the conditions for certain facts to be objectified, argued, and exposed.

Furthermore, this literature shows the political and ontological vocation of representation and experimentation technologies. If what we are searching for has no relation to the 'Aristotelian ques-tion' about the degrees of adaptation of science with 'Nature,' but is linked to the activities that make reality speak, then how devices enable and articulate the existence of certain entities becomes the overriding question (Daston and Galison 2012). Each regime of delegation (Callon et al. 2001), ver-ification (Daston and Galison 2012), or demonstration (Rosental 2003) offers techniques for inter-vening in reality. In other words, they create protocols for provoking the real.

As part of this ontological dimension of experimentation technologies, some authors have sought to establish trial pragmatics (Latour 1984, Boltanski and Thèvenot 1991), advancing the argument that which is real has resisted a test (Latour 1990). Latour develops the concept of the test of strength, in which the idea of 'real' or 'objective' follows a series of tests. This practice allows us to verify the 'texture of reality.' Thus, the notion of proof is related to ontological uncertainty (Barthe et al. 2013). Following Dewey, the test always raises uncertainty even as it allows for the verification of certain qualities. Boltanski and Thèvenot (1991) proposed a non-substantialist way of apprehending the processes of dispute and agreements. Instead of endorsing entities with certain properties, they

try to understand these properties based on the evidence revealed in situated action, establishing a clarification policy.

This 'ontology of variable geometry,' which introduces the pragmatist notion of testing, has inspired research on how to forge the demarcation between human and non-human (Lestel 2001, Despret 2002, Descola 2005, de la Cadena 2010, Rémy and Winance 2010, Michalon 2011). It is necessary to politicize the strategies of modern metaphysics aimed at dividing humans from nonhumans by empirically examining the protocols, methods and forms of representation used to make this demarcation (Descola 2005). Depending on the observations and the testing device to which the animal is subjected, we will obtain different ontological canons (Rémy 2009). Rémy and Winance (2010) proposed reproblematizing the concept of 'common humanity,' exploring the moments of testing, negotiation, and imposition that determine how the actors define the 'limits of the human.'

The prototype as a material technology that can be used to test certain aspects of a design project has evolved significantly since its inception. During the seventeenth century, the word 'prototype' represented the idea of a perfect model. By the nineteenth century, it started to be considered the first real model of an object (Henderson 1995, During 2002, Corsín Jiménez 2014). Recently, the anthropological and STS approach to design has led to an interest in understanding prototyping as a generative and emergent event. Wilkie (2014) argues that the prototype's relational and experimental behavior enables it to objectify and create multiple developments, achieving enactment based on present practices and manufacturing plausible futures in which multiple interests and ontologies are intertwined. Prototyping also has been conceptualized as a promoter of agonistic and political relationships (DiSalvo 2012, DiSalvo 2014) or the proactivity of the idiot (Michael 2012). Along this line, the prototyping process does not only serve to better understand users but to explore how entities are constituted by interaction, enacting ways of engaging with the world (Michael 2012). For Michael (2012), the logics of prototyping offer an opportunity to slow down the processes and generate what the author calls 'inventive problem making.' As such, prototyping can be conceived of as a space that creates new relationships and entities beyond the strictly human (Binder et al. 2015, Lenskjold et al. 2015, Rice 2017) and that makes it possible 'to make visible what is emerging' (Rabinow et al. 2008, p. 64).

Moreover, Corsín Jiménez (2014) highlights the experimental and recursive vocation of prototyping as a 'choreographic composition' of heterogeneous times, ontologies, and spaces that unfolds (like in a dance) around the prototyping. We will see how in this case the performativity of prototyping allows certain situations that we want to understand as interspecies co-design processes, adding to the event the potential to produce 'encounter value' (Haraway 2008). Following Donna Haraway, 'encounter value' can emerge 'among a motley array of lively beings, in which commerce and consciousness, evolution and bioengineering, and ethics and utilities are all in play' (Haraway 2008, p. 46). In this case, the 'motley array of lively beings' occurs when all entities involved participate in trial and error processes.

One of our contributions to the debate on prototyping will be to empirically revisit its emerging effects in the NZSCH, showing how its testing and failures become a place for cosmopolitical encounters. Although 'anthropocentric' is an epithet for the zoological institution, we will argue that prototyping can be conceived of as a cosmopolitical event when installing modalities of exploration open to heterogeneous and inventive forms of interspecies encounters.

In contrast to the Kantian idea of cosmopolitanism – a sort of teleology of European' politics and economics, both considered as models to impose on all cultures and institutions around the world (Derrida 1997) – Isabelle Stengers' cosmopolitics (2005) is an effort to conceptualize the 'meshwork' (Ingold 2016) constituted by all entities confronting the ecological crisis arising from the implementation of the aforementioned European' models on a global scale. If the politics of cosmopolitanism are based on 'Progress,' predictability, and human control – or, more precisely, bourgeois control – Stengers' cosmopolitics does not believe in the predestination of our forms of social organization, is skeptical about matters of fact, and opens up decision-making to include unreasonable criteria and nonrepresentational and performative manifestations. Diversity is not enough to constitute the

cosmopolitical: its 'new pluriversal political configuration (…) would connect different worlds with its socionatural formations – all with the possibility of becoming legitimate adversaries' (de la Cadena 2010, p. 361). The ecological adventure of cosmopolitics re-composes the 'purified' and anthropo-centric notion of politics to integrate antagonistic co-existences and modes of attention (Ingold 2016) among ontologically multiple entities that intervene in the world (Latour 2002, Stengers 2010).

By highlighting and supporting performative interspecies encounters in which Judy and Gombe can make their subjectivity visible by modifying the prototypes they interact with, prototyping defies the traditional limits of the political. In other words, it makes visible and verifiable those who are normally 'neither subject nor object of modern politics because [their] status is doubtful' (de la Cadena 2017). We see certain indications that this prototyping process opens up politics by invoking and evoking politically invisible entities. Its cosmopolitical dynamic defies the system of exclusions that constitutes political action and, at the same time, its 'blind spot.' Following de la Cadena, to 'unblind this spot offers the possibility of exposing the self-evidence on which the ontological statute of modern politics rests' (de la Cadena 2017). This perspective invites us to go beyond a representational view of 'other-than-human beings', to explore the typifying and translation operations that integrate them into society (de la Cadena 2010). But this supposes, as Mario Blaser states, to practically consider other 'ontologies seriously necessarily goes beyond the immediate politics of a given project or institution' (Blaser 2009, p. 18).

To avoid installing an a priori definition of cosmopolitics, we seek to empirically describe how our prototyping experience allows us to jump from cosmopolitics as an understanding of the world to materially speculate on how to co-produce cosmopolitical environments.

Prototyping an environmental enrichment program

Environmental enrichment initiatives at NZSCH, which focus on the physical and psychological health of animals in captivity, do not attempt to replicate the surroundings in which each species originated, multiplied, and probably started to become endangered. In fact, most of the animals in captivity have never lived in their original ecosystems. They have traveled the world by sea or air and have been given names. They have political representatives that defend their interests and, for some time now, teams of designers have undertaken ethnographic studies on them and develop prototypes that they can accept, modify, or reject – just like customers of Starbucks, LATAM Airlines, McDonald's, or the Public Health Service.

In 2013, the IDW began working with the NZSCH, altering the epistemological assumptions upon which design practice was based. Prior to the alliance with NZSCH, projects focused on human recipients from an ethnographic perspective. Borrowing precepts from interaction design (Laurel 1991, Norman 2002, Laurel 2003, Salen and Zimmerman 2003, Norman 2004, Moggridge 2007), the IDW worked with an anthropocentric vision, addressing situations or events that involve human informants who could narrate their experiences and perceptions. Design projects were based on an 'other' that was culturally close and able to verbalize its needs. In this context, a verbally structured design script fluidly and substantially incorporates its audience's ability to speak. Given that animal-recipients lack a language with which to make their needs explicit, the first design challenge was translating animals' needs into design scripts. But how could we give epistemic and empirical credibility to design decisions when faced with non-human actors? How could we translate the animal world for design?

We will show how prototyping an environmental enrichment tool for Judy and Gombe evolved from the traditional kind of design that includes prescriptions for its users to a prototyping which, exercising a kind of cosmopolitical diplomacy, unfolded modes of mutual interaction and singularization among humans and nonhumans. Due the evolution of the prototyping process, designers moved from an anthropocentric design practice to engage with and intervene in a multi-species ecology. We will show how the scope of the prototyping transcends the generation of provisional models of a product (During 2002, Corsín Jiménez 2014), making explicit and translating the psychological, social and physical features of the entities involved. In this case, the prototyping cannot be reduced to

a role of 'boundary object' (Star and Griesemer 1989) or 'social adhesive' (Henderson 1995) because it creates a cosmopolitical ecology composed of valuable encounters between diverse ontologies. In a speculative move, we project the prototyping of cosmopolitical encounters as a way of enacting new forms of citizenship: performatively, our aim is to recognize and make visible the power and relevance of nonhumans.

Fine motor skills as a design opportunity

The prototyping experience with Judy and Gombe was one of the first that the IDW conducted with zoo animals. Since designers did not have enough experience with non-human recipients, they applied an ethnographically inspired methodology – in other words, an anthropocentric one. A design opportunity had to be formulated prior to prototyping. To this end, designers had to identify a problem that could be addressed using the available resources and timeframes. While the design opportunity is sustained by theoretical and empirical exploration, their purpose is not only to produce knowledge but to operationalize it through a project.[3] As part of their efforts to identify their 'design opportunity,' students observed, recorded and developed detailed descriptions of the interactions between the different actors at the NZSCH such as visitors, the weather, staff, topology, enclosures, shadow casting, equipment or data flows. Based on the assumption that zoo enclosures present fewer incentives and demands than the original environments of each species, the actions and devices designed were meant to 'increasing the variety and range of opportunities or choices to animals in captivity' (Mellen and MacPhee 2001, p. 214).

The design team whose aim was to develop environmental enrichment for Judy and Gombe, *Los Chimpáticos*,[4] looked for their design opportunity by comparing their own ethnographic survey of the chimpanzees' enclosure to ethological descriptions, namely, descriptions of chimps spontaneous behavior in their natural environment (de Waal 2007):

> When we compared the eating habits of chimpanzees in wild environments with those observed in the zoo enclosure, it became evident that there was a need to stimulate the cognitive and physical work of the chimpanzees Judy and Gombe during their feeding routines. (Chimpáticos 2014a)

According to experts from NZSCH and scientific documents, strengthening their fine motor skills was an important element to develop. The size, configuration, and equipment in Judy and Gombe's enclosure confirmed the importance of promoting the maneuvering of small-scale mechanisms. Their preliminary design opportunity was thus 'finding and obtaining food stimuli at a significant height to promote the development of their fine motor and cognitive skills' (Chimpáticos 2014a).

Making the project tangible

The next step was to translate the design opportunity into a 'script.' After students creatively speculated with the data – using text, photos, diagrams, videos, 2D and 3D views – the initial question was refined and defined: What is the appropriate configuration and complexity of a puzzle that would encourage Judy and Gombe to try to find fruit inside of it? The first prototype was designed and built to answer that question, moving from an external, disembodied observation of recipients to forms of verification and knowledge production that emerge from the prototyping as an encounter platform. The main actors involved were Judy and Gombe – who explored, used and defies the prototypes – the professionals at the zoo – who commented on and installed the prototypes – and the IDW students and staff – whose role was to design, produce, and interpret how each prototype would be used.

The first prototyping cycle: Judy and Gombe pound the table and make themselves known

The Chimpáticos coordinated their research under the guidance of the faculty, staff, and NZSCH safety protocols and developed the first of three prototypes. Each required innumerable

micro-negotiations among multiple actors who speculated on the characteristics that should guide the prototyping. Prior to entering Judy and Gombe's enclosure, the discussion of the materials and assembly techniques to be used in this prototype was a source of controversy. For example, regarding the joint system, the designers focused on economy of resources and the speed of the prototyping and argued in favor of using screws, which could be quickly placed and removed to reuse the materials. The zookeepers were concerned about Judy and Gombe's capacity for destruction – particularly that of Gombe – and felt that it was necessary to use wood glue in addition to the screws even though that would make it impossible to reuse the pine planks. Employing arguments based on principles of animal wellbeing, the scientists working at the zoo suggested replacing the metal screws with wooden dowels. While it would be easier for a chimp to break a dowel, if they managed to dismantle the box they would not be able to use the metal as weapons. Finally, the university workshop technicians suggested that the planks be snapped together, cutting their edges with a computer-controlled tool. This apparently banal consideration was just one of the many problems that would have to be resolved prior to implementing the prototype. This reveals the heterogeneity of the approaches and assessments that came into play and the complex ecology of relationships and interests that the prototype calls up and that must be addressed.

The first prototype was a wooden box attached to one of the trees in the enclosure (Figure 3). Its height – which allowed Judy and Gombe to operate it comfortably when standing – was selected by the zookeepers during the installation of the box.[5] This device was a maze through which Judy and Gombe would push a piece of fruit with their fingers to release it as a prize. The maze's shape, size, and colors were based on ethological descriptions of the chimpanzees as species. The expected behavior, enfolded in the script of the prototype, was a sequence of operations that, once repeated, would stimulate the development of fine motor skills.

However, the results were far from what was expected. Judy, the first to come and inspect the prototype, moved the fruit with her finger but in the opposite direction to the one intended. Hacking the carefully designed protocol, Judy's trickery destabilized the logic of the prototype, allowing her to access the fruit without using the planned movements. In a gesture we want to interpret as Certeaunian, Judy subverted the device, activating her fine motor skills throughout this appropriation (de Certeau 1984). After Judy ate the fruit and walked away from the prototype, Gombe approached, inspected it for a couple of seconds and turned away indifferently (Figure 3).

From the laboratory experiment – as described by Shapin and Schaffer (1993) – prototyping borrows the pragmatic element of the test but prioritizes performativity over textuality to restore and socialize that which is discovered. Furthermore, because this instance of prototyping analyzed engaged human and non-human beings, it added an extra challenge to the capacities of textual narrations to efficiently inform and translate this testing event. The unexpected behavior of Judy and Gombe with the prototyping showed that each has their own personality. The Chimpáticos' interpretations of Judy and Gombe's behavior, which were based on general ethological considerations and used to design this prototype, were not useful. This initial collision was an indicator that uncertainty is constitutive of interspecies encounters and of the need to slow down in order to co-exist with the overflows and confusions between the subjectivities involved.

Re-designing the device: Judy as the main recipient

The first prototyping cycle suggested the recognition of Judy and Gombe as singular beings: students could not predict their clever reactions after reading ethological descriptions of chimp's behavior in non-urban environments. The unpredictability of animal behavior is vividly discussed in the specialized literature (Mellen and MacPhee 2001, de Waal 2007). Judy and Gombe's complex behavior changed the approaches of all of those involved with the prototyping. The designers, supported by the zookeepers, had to agree not to impose their script on two users because Judy and Gombe imposed their respective singularities through the use, appropriation and modification of the prototype. The uniqueness of each one pushed the design team to redefine the recipient of a second
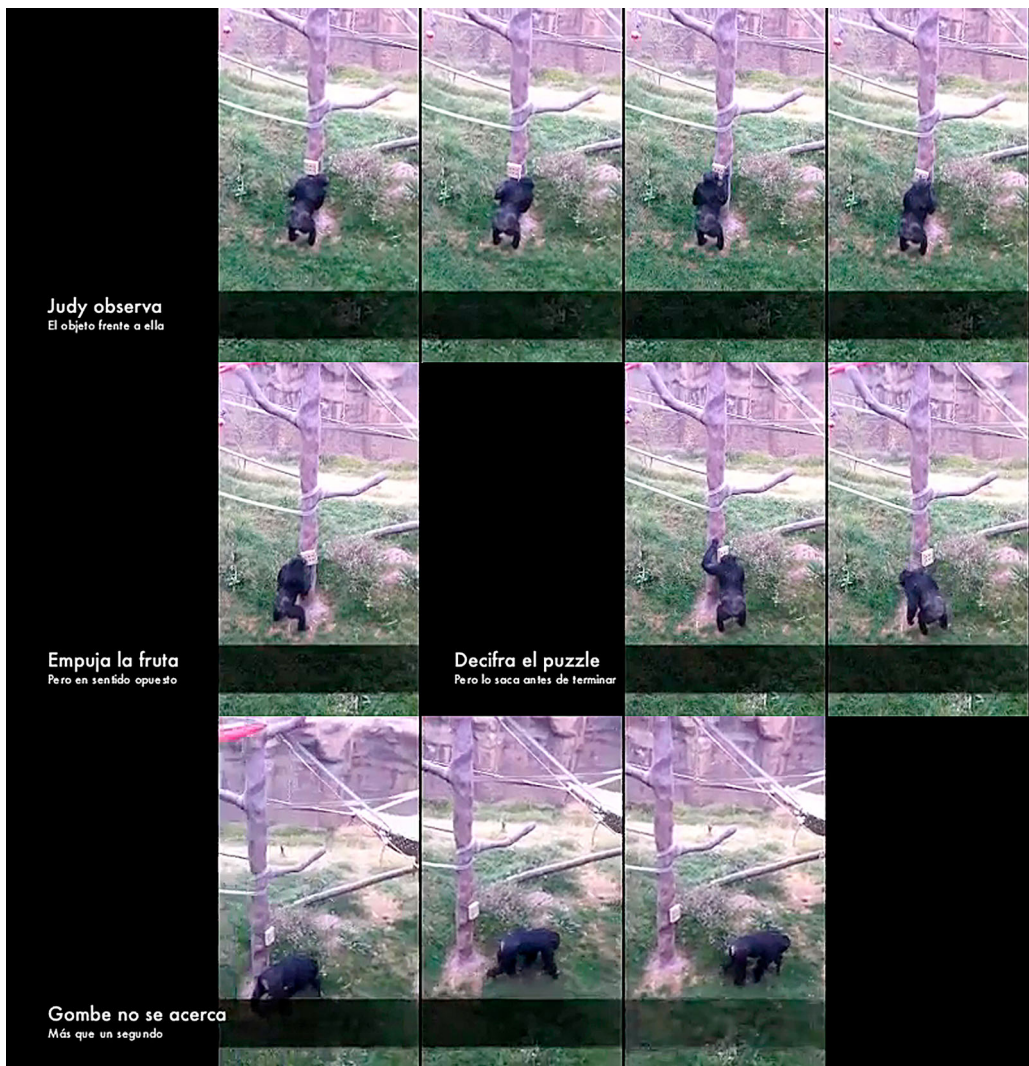
Figure 3. Testing sequence of the first prototype (Chimpáticos 2014b). Original video: https://www.youtube.com/watch?v=vEU9730Gyjs

prototype: Judy became the center of attention because she had outwitted the prototype's interface. The designers retained several features of the first prototype, that is, a height that could be reached by the apes, the overall size of the object, materials, and basic colors to mark and match its parts. They then modified two elements that substantially altered the actions that the chimps would have to take. First, since Judy had managed to subvert the prototype while getting the fruit, the team decided to replace it with honey since, unlike the fruit, it couldn't be removed in a single attempt. This also required less frequent refills given that honey is not perishable. This reinforced the practical value of the device and made installation and maintenance easier for the zookeepers, which was necessary to allow them to incorporate the environmental enrichment device into their daily routine.

The second modification evolved as a result of Judy's subversion of the first script. The first version was based on preset interactions endorsed on the interface that contains all the necessary parts for its operation: the original script prescribed the animal to remove the fruit from the maze using its fingers with prearranged movements. The new prototype consisted of a partial redistribution of its

intelligence, introducing two sticks to reach the honey that hang freely from the box, to expand Judy and Gombe's maneuvering range.

The second prototyping cycle: from fine motor skills to a teaching device

Judy and Gombe subverted the script of the second prototype in their very first interaction. In order to offer the subjects limited freedom of choice, the designers made two different holes from which they could extract honey. To obtain the sweet prize, Judy, the main recipient, would have to match a triangular stick with a triangular perforation and a round one with a round hole. To facilitate this, each stick was the same color as its corresponding hole. However, once the prototype was installed in the chimpanzee's enclosure, the couple redesigned and reprogrammed it at will.

Gombe, who immediately took the lead, grabbed the sticks, licked them, and threw them on the ground (Figure 4). Then, realizing that there was honey inside the box, he climbed the tree, grasped the wooden box firmly and shook it violently to modify the rules of the game. First, Gombe circumvented the testing of the sticks – the shape and color of which had been carefully designed to suit Judy's fine motor skills and associative abilities. Then, when trying to break the anchorage of the device, Gombe extended its range of performance. He exerted physical force on the box and its anchorage to hack the script of the second prototype and obtain the honey he detected inside the object, without being subjected to its logic or having to perform tricks to subvert its mechanism. After his brief but intense attempt to violate the box, Gombe walked away.

Under Gombe's gaze, Judy calmly approached and inspected the artifact thoroughly and gently. After rummaging in the cavities from which honey is obtained with her finger, she improvised a tool by picking up a stick and introducing it into the device. During this process, she tried sticks of different thicknesses to make the extraction of honey easier. After trying three sticks, she kept the thinnest. By carrying out her own prototyping procedures, she extended and re-specified the design process, introducing a trial-and-error exercise in the same way a designer does. Both Gombe's deconstruction of the prototype and the enfolding will that underlie the prototyping were subverted by Judy's appropriation of the environmental enrichment. Her performative questioning of the script introduced a *balancing element* to the process: designers can only be modest about their findings since the iterative design process makes the boundaries of authorship permeable.

After observing Judy's activities from a distance, Gombe approached the prototype again. This time he approached cautiously, climbed the tree, and watched Judy's movements. Ten seconds later he picked up a stick and imitated his partner, adopting her actions and calm mood. After this initial learning instance, Gombe went a step beyond simple imitation and molded his tool with his teeth by bending it, increasing its efficiency. Like Judy, Gombe joined the prototyping and redesign exercises, but he did so on his own terms: by shaping the tool – rather than trying different shapes – he deployed a different tactic.

A result not considered in the script was the exchange of knowledge between Judy and Gombe. By observing each other producing and using the stick to extract the honey, they engaged in co-design activity and constituted themselves as actors in the prototyping. Judy and Gombe not only imposed their individual preferences and moods on the ecology of the prototyping, but they did so as a couple, too. This makes it clear that the script – a verbally structured device – was unable to usefully inform the development of the prototyping process.

The chimps revealed a complex personality that is impossible to understand through general ethology readings or from a few weeks of observations and interactions. Likewise, their relationship was not a straightforward matter. Anticipating whether the young-male or senior-female will take the initiative depends not only on the qualities of the interface that is being designed or whether it is carefully customized, but mainly on the mood of the animals and the context.

By establishing a dialogue between different social worlds (Star and Griesemer 1989, Henderson 1995) – chimpanzees, designers, and zookeepers – the prototyping revealed unforeseen abilities and specificities. The prototyping event also changed the approaches and epistemological foundation
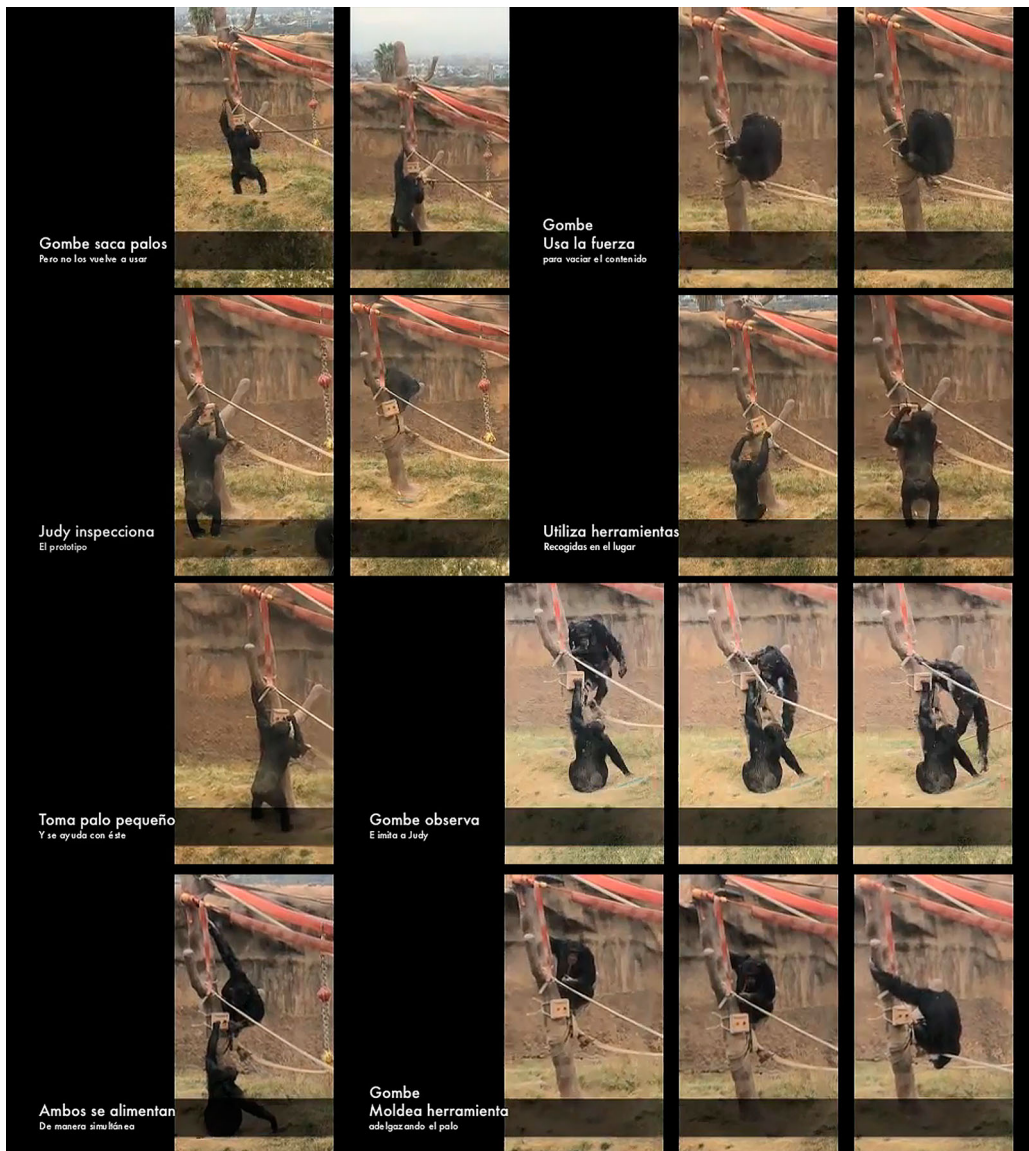
Figure 4. Testing sequence for the second prototype (Chimpáticos 2014b). Original video: https://www.youtube.com/watch?v=vEU9730Gyjs

that underlay the design work. In other words, the prototype could no longer function as a mere testing instrument or 'trick' designed to impose a script on a user. Instead it progressively precipitated a cosmopolitical encounter. Prototyping favors careful and reciprocal attention between humans and nonhumans while they modify each other.

Finally, the design team became aware of Judy and Gombe's complex personalities and understood their performances as claims to obtain devices that offered a wider range of possibilities for play. Throughout the process of prototyping, the singularity of Judy and Gombe was materialized, along with that of the designers – particularly their limitations and blind spots – and the zookeepers – expressed in a growing consideration of their modes of interaction and understanding of Judy and Gombe.

The personalities exhibited by Judy and Gombe and their capacity to performatively impose their mood put an end to the idea that the final device should be a stable solution to a clearly determined

problem for a very well defined user. The third prototype could not be sustained solely on an expected behavior, that is, a rationalization of the animal. It had to incorporate the openness and uncertainty that emerged from the clash of incommensurabilities. The team decided that it should be open enough for Judy and Gombe to create and try out new ways of extracting honey (Chimpáticos 2014b). The design team decided to develop a device with an open grammar script that would respond to the unpredictability of the encounter and the actors' intelligence. In contrast to the first prototype, which sought to impose a measurable and linearly structured activity, and the second, which tried to engage Judy and Gombe so that they would complete the script, the third (Figures 5 and 6) was designed so that both would work to obtain honey without imposing a way of use, starting point, or mandatory route.

The material recognition of every actor's recalcitrance in the final prototype – resulting from the slow down and misunderstandings – suggests the presence of 'encounter value' (Haraway 2008) through the prototyping process. The meshwork prototyped, which is composed of intimacy, care, physical health, and the optimization of feeding routines, went beyond the boundaries of the traditional environmental enrichment device.

Prototyping cosmopolitical encounters

In 'The political career of a prototype,' Henderson (1995) argues that the prototype can be conceived of as political technology not only because it allows for material representations of certain social interests, but primarily due to its ability to recruit and coordinate multiple actors. Here we have tried to recognize a different mode of how the prototype could participate in and enact political relationships. By considering both the material device – namely the prototype – and the performativity of prototyping as political, a common ground is insinuated for cosmopolitical encounters, thus evidencing ontological work when prototyping. Judy and Gombe's case allows for a shift from the prototype as a political tool to the prototyping of cosmopolitical encounters. The political nature of prototyping is not reduced to the ability to coordinate multiple actors, that is, simply to serving as a boundary object (Henderson 1995). Rather, the prototype's cosmopolitical path proceeds from the capacity to precipitate encounters among humans and nonhumans, becoming permeable to recalcitrant and incommensurable events.

The potential of prototyping to precipitate cosmopolitical encounters is far from a peaceful new capacity that promises to expand the borders of the design practice. On the contrary, we see it as a potential irruption that is capable of creating a conflict inside the discipline, because it interpellates the core beliefs of modern and client-oriented design. As an ontological conflict, a cosmopolitical encounter inoculates 'a recalcitrant anomaly that constantly makes evident what modernity cannot seriously negotiate without coming undone: namely, the existence of multiple ontologies or worlds' (Blaser 2009, p. 18).

Figure 5. The third and final prototype installed at NZSCH for regular use (Chimpáticos 2014b).

Figure 6. The third and final prototype installed at NZSCH for regular use (Chimpáticos 2014b).

As we have shown, prototyping cosmopolitical encounters does not follow a rational program or effort to manage cosmopolitics. As it develops, it reveals itself to be an event plagued by misunderstandings in between the recalcitrances in play. Following Stengers (1997, 2005, 2010), recalcitrance has to do with an attribute of the entities studied to object or be indifferent or indocile to the purposes sought by the researcher – or, in this case, by the designers. As a result, recalcitrant situations tend to provide inventive and unexpected responses that laboratory science tends to minimize (Savransky 2014). By contrast, the case examined here shows how prototyping is emancipated from the questions anticipated by humans to become a space for speculative exploration and a permanent re-interrogation regarding their own scopes and possibilities. The encounters articulated by the malleability of the prototype allowed animals to subvert the scripts proposed by designers (Despret 2008), becoming recalcitrant co-designers that modified the process of environmental enrichment.

If the work of diplomacy proposed by Latour (2012) involves exploration and dialogue operations between different ontologies, prototyping invites us to experience and redesign these activities. As Haraway (2008) has stated, the need to address the coexistence of multiple ontologies is not only a matter of ethical abstractions. These matters require places of exploration that allow for the confrontation of forms of recalcitrance at play and inform future scenarios for interactions among different ontologies. Here we have tried to demonstrate that prototyping provides a singular grammatology and can re-specify itself, opening up diplomatic means of intervention and exploration. In this case, the process of prototyping allowed for movement from a logic of design centered on the user to an ethics of careful inquiry, encounter, and even co-design, open to forms of antagonism, resistance, and correspondence (Ingold 2017). Following (Stengers 2010), one could say that this ethics of care forced a re-imagining of new possibilities for multi-species design, in which a position that had been unthinkable was assigned to non-human actors, as observed by Jönsson and Lenskjold (2017) in their work on urban-animals as significant others. This form of cosmopolitical encounter enters into dialogue with Rubio and Fogué (2014), who argue that design as a form of unfolding worlds enables cosmopolitical production because of its ability to explore and extend the cosmos of the political. Going further, we argue that it is not design in general, but the prototyping process itself that can be conceived of as a cosmopolitical device, to the extent that prototyping favors the

coming together and interaction of multiple ontologies, deploying their own forms of recalcitrance while opening themselves up to mutual modification.

The provisional nature of prototyping raises the question of ontological uncertainty: the recalcitrances of the designers, the zookeepers, or Judy and Gombe cannot be defined through immanent qualities and conditions. On the contrary, each quality deployed by those involved is linked and acquires meaning in a specific moment and is situated in one of the cycles of prototyping and testing. In contrast to the conventional precept that conceives of prototype failures as a necessary moment for the realization of the final product, the tensions and misalignments among our actors are not described as errors or bad decisions: they are moments of inventive play during which this ecology of temporary practices is performatively constituted (Stengers 2013). Here we find a radical distinction between scientific experimentation and prototyping: in contrast to sanitization and control of variables, which the scientific seeks out through laboratory testing on animals – in which their bodies are docile and available to their intervention – at the NZSCH, prototyping opens up spaces for recalcitrance and incommensurability, conditions of possibility for the cosmopolitical. As such, the distinction between evaluator and evaluated, designer and audience, the author and the subject of interaction all becomes a controversial and agonistic space that is constantly redefining itself. In short, the ephemeral spaces of recalcitrance and incommensurability, which we call the prototyping of cosmopolitical encounters, can politicize the exercise of design.

In this study, we wanted to describe how a prototyping process that merges ontological research and design practice problematizes the assumptions and ontological implications of user-centered and problem-solving design methods (Hunt 2011, Hermansen and Tironi 2018). Prototyping precipitates the slowing down of relationships between different ontologies: the forms of negotiation and singularization described here between designers, zookeepers, Judy and Gombe incorporate idiocy, misunderstandings and misbehavior (Stengers 2005). The lack of stability described introduces an ecology of attention and care to all forms of existence. Or, based on the work of María Puig de la Bellacasa (2012), we could claim that prototyping provides spaces for 'thinking with care,' that is, for certain gestures of mutual vulnerability where our recipients of care can answer.

The cosmopolitical plan proposes a conceptualization of a social life in which we recognize in all entities the ability to participate in the creation of a co-inhabited cosmos. To do this, it is essential that we explore devices that allow us to experience the design of cosmopolitical atmospheres. To what extent must the notion of Stengersian cosmopolitics also be prototyped and empirically tested? If cosmopolitics has regard for the way in which entities come together and slowly co-emerge, unfolding new places and spaces for rethinking the political (Stengers 2005), prototyping could play a critical role in its design process (Tironi 2017). If cosmopolitics forces us to rethink political action as an ontologically plural activity, what methodological, epistemological, and project-based repertoires are necessary to move us from cosmopolitics as an analytical horizon to cosmopolitics as design experience?

In this article, we have suggested that prototyping makes the cosmopolitical a matter of design. Stengers suggests that cosmopolitics requires the recognition and creation of obstacles to slow down and wonder 'what if?', like the idiot, a character taken by Deleuze from Dostoyevsky, does. In our case, prototyping provokes recalcitrant situations, contributing to the rethinking of material interventions in order to create new repertoires of entanglement among human and other-than-human beings. As a form of speculation, prototyping should play an important role in the cosmopolitical program by allowing for the exploration of potential relationships that go beyond human exceptionalism. It makes it possible to test contact and collaboration zones that have not yet been defined between multiple entities. Cosmopolitics is not a starting point, but a place that demands compositional work, empirical research, and design operations.

Notes

1. The staff responsible for looking after the animals and their enclosure.

2. During the first semester of 2014, this team worked as part of the IDW course and within the framework agreement between the NZSCH and the School of Design of Pontificia Universidad Católica de Chile. This article was written by two of the academics who directed the IDW and observed the various stages implemented by the design team analyzed.

3. A design opportunity shares similarities with a scientific hypothesis, but the former is built while explicitly intertwining theoretical reflection and creative intuition until the two are indistinguishable.

4. The group *Los Chimpáticos* was formed by students Ricardo Aliste Salvo, Catalina Delanoe Garcés, Anath Hojman Betancourt, Felipe Orellana Fuentealba, and Matias Salinas Poblete.

5. Only zookeepers could come into direct contact with the animals. This formed co-design diagnostic forms for prototyping while exacerbating the relative autonomy of the prototypes concerning the designers.

Disclosure statement

No potential conflict of interest was reported by the authors.

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