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► **To cite this version:**

Cédric Sueur, Michael A. Huffman. Co-Cultures: Exploring Interspecies Culture Among Humans and Other Animals. 2024. hal-04368545v1

HAL Id: hal-04368545

<https://hal.science/hal-04368545v1>

Preprint submitted on 1 Jan 2024 (v1), last revised 23 May 2024 (v3)

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Co-Cultures: Exploring Interspecies Culture Among Humans and Other Animals

Cédric Sueur^{1,2,3}, Michael A Huffman⁴

1 Université de Strasbourg, IPHC UMR7178, CNRS, 67087 Strasbourg, France

2 ANTHROPO-LAB, ETHICS EA 7446, Université Catholique de Lille, 59000 Lille, France

3 Institut Universitaire de France, Paris, 75005 France

4 Primate Research Institute, Kyoto University, Inuyama, Aichi 484-8506, Japan

Corresponding author: cedric.sueur@iphc.cnrs.fr

Highlights

1. Recent advancements in interspecies social learning underscore the fluidity of animal behaviour, revealing complex adaptations to interactions across species, including humans.
2. The concept of ‘co-culture’ emerges, spotlighting a dynamic, parallel or conjoint cultural evolution between different species, reshaping traditional views of cultural and evolutionary processes.
3. Studies of the parallels between human and animal use of medicinal plants in the same environment, and animal origin stories of some of the major medicinal plants in the pharmacopoeia of traditional societies around the world suggest medicinal co-cultures have been evolving throughout our species’ history.
4. Studies in urban animal cognition provide insights into how wildlife adapts to human-modified environments, signalling significant shifts in behaviour and learning.
5. The dynamic field of interspecies networks highlights how complex social and ecological interconnections influence behaviours and strategies for survival and coexistence.
6. The integration of cultural and genetic coevolution in species interactions points to deeper, symbiotic relationships shaping evolutionary pathways in a shared environment.

Abstract

We introduce the concept of ‘co-culture’, a novel framework for understanding the mutual cultural evolution between humans and other animal species. It explores the dynamics of interspecies interactions, particularly in how different species, including humans, influence each other’s behavioural and cognitive adaptations. We highlight various instances of interspecies cultural exchange, such as the acquisition of medicinal plants from animals resulting in a shared medicinal culture, adaptive behaviours of urban wildlife, and cooperative hunting practices between humans and dolphins, illustrating the sometimes bidirectional nature of these relationships. We challenge the notion of species-specific culture, underscoring the complexity and interconnectedness of human and animal

societies, and between animal societies. We advocate for further research into co-culture, emphasising its implications for conservation, urban planning, and a deeper understanding of animal cognition and behaviour.

Keywords: social learning, niche construction, cultural evolution, cultural coadaptation

Introduction

Cross-context responses to novelty in the animal kingdom have increasingly been the focus of study, underscoring the extensive and intricate nature of interspecies interactions. These mechanisms of social learning, transcending species boundaries, are remarkably diverse, encompassing a spectrum from explicit imitation to more nuanced forms of influence such as stimulus enhancement or social facilitation [1,2]. This domain of animal cognition is particularly salient in the interactions between non-human animals and humans, especially pronounced in urban environments [3]. Such settings, with their unique blend of challenges and opportunities, become fertile grounds for novel forms of adaptation and interspecies interaction. A case in point is the observed behaviour of herring gulls, which have adapted to mimic human food preferences during foraging, demonstrating a form of interspecies stimulus enhancement [4]. In a similar vein, wild mockingbirds living in urban areas have shown the capacity to differentiate between individual humans, suggesting a level of social cognition that equips these birds to adeptly navigate the complexities of human-dominated landscapes [5].

Interspecific social learning, where animals can acquire and adopt novel behaviours from other species [1,6], demonstrates the fluidity and adaptability of animal behaviour in the face of interactions with different species. For example, research has demonstrated that wild songbirds leverage interspecific social networks to disseminate information, thereby affecting their survival strategies and behaviours [7]. These networks represent the complex and nuanced ways in which information flows across species boundaries, profoundly influencing the ecological and social landscapes. The emerging field of interspecies social learning, exploring how different species, including humans, exchange, learn, and co-evolve through social interactions, presents a new and exciting realm of study in anthropology and animal behaviour. This concept is supported by a plethora of studies and theories that collectively unveil the complex dynamics at play in these interspecies relationships, providing insights into the cognitive and behavioural adaptations that arise from these interactions.

However, much of the existing research has focused predominantly on one species adapting and modifying its behaviour in response to another, while the process might be more accurately described as bidirectional. In this context, we introduce the concept of 'co-culture' or interspecies culture.

Defining the concept of co-culture

In their pioneering work in 2005 [8], Marzluff and Angell introduced the concept of cultural coevolution, marking a significant milestone in evolutionary studies. Despite its significance, research on co-culture in human and animal evolution remains limited. We emphasise its

importance, proposing a dynamic interplay between human culture and the environment. This coevolution involves humans and other culturally developing species. Interactions between humans and these species can accelerate cultural evolution for both. Additionally, this process occurs between non-human species as well. The concept suggests concurrent and reciprocal behavioural development between different species, visible in some populations, leading to joint cultural evolution over time (figure 1) [9]. For co-culture to manifest, it is essential for the populations of both species involved occupying the same geographical space and to participate in either direct or indirect interactions.

The co-culture concept not only implies that two cultures are co-evolving in two populations sharing spaces and interacting but that the two populations are sharing a common culture. This framework aligns with and extends the concepts of co-creation and coevolution [10] in understanding how collaborative processes lead to the formation of new nature-culture structures. It also considers how these processes are intertwined with cultural and ecosystem changes over time. This reflects a dynamic and mostly symbiotic evolution of interspecies relationships, underlining the interactive and interdependent nature of these associations. Furthermore, due to their adaptable nature, cultures are prone to rapid transformations in response to the changing dynamics of social selection. This fluidity propels a cycle of dynamic interactions and fine-tuning to the local environment, highlighting the malleable and responsive character of these interspecies relationships [9]. Co-culture can be seen as a specific form of niche construction, where the focus is on cultural modifications of the niche (figure 1) [11].

Interspecies culture cases

- Human-animal medicinal cultures

Throughout human history, the acquisition of some medicines has been attributed to the observation of wild animals' use of many different plants to treat perceived illness or otherwise alter their physiological or psychological state for positive benefits [12,13]. Recently this practice became a science in itself, proposed as a means of acquiring new medicinal plants for human use [14]. The study of animal self-medication has revealed many examples of shared pharmacopeia by humans and animal species sharing the same habitats [15–18]. Not only do humans acquire animal medicines, but wild animals living in human-dominated landscapes also acquire new plants of medicinal value.

- Japanese macaques and Sika deer interactions

Direct interactions between Japanese macaques and Sika deer exemplify the evolution of interspecies relationships. Initially, these species developed close spatial proximity, benefiting mutually from their coexistence. Macaques, when feeding in trees, inadvertently drop food which becomes an energy source for deer, enhancing their foraging efficiency through gleaning, as noted by Tsuji et al. [19]. This interaction fosters a strong cohabitation dynamic between the deer and macaques. An unusual aspect of this relationship is the deer's coprophagia, particularly around macaque sleeping sites, where they consume the macaques' faeces [20]. As this relationship evolved, some macaques have been observed grooming deer, a behaviour suggesting a deepening of their interspecies bond. On

Yakushima Island, this interaction has progressed into a unique co-culture, with macaques riding on Sika deer [21]. Similar behaviours were observed between rhesus macaques (*Macaca mulatta*) and sambar deer (*Rusa unicorn*), indicating the potential for such complex interspecies interactions to occur in other environments and species [22]. Interestingly, these interactions have led to interspecies sexual behaviours, as observed in Yakushima and Minoo prefecture, Japan. These instances involve male macaques engaging sexually with female Sika deer and, conversely, female macaques with male deer. Such interactions highlight the capacity for highly complex and unusual behaviours to develop between different species living in close proximity. The evolution of their interactions – from shared foraging and grooming to more complex behaviours like riding and interspecies sexual activities – demonstrates a significant level of social and behavioural adaptation between two distinctly different species. They learned from each other and developed co-cultural behaviours.

- **Humans and liminal animals in urban environment**

The varying behaviours of Japanese macaques towards humans, shaped by human reactions, are a clear manifestation of co-culture. In designated monkey parks, these macaques fed by keepers for tourist viewing, a practice initiated to divert them from crop fields. This feeding has led to a peaceful coexistence, with macaques positively adapting to human presence. Conversely, in areas where they are perceived as pests, aggressive human actions have resulted in macaques developing fearful or hostile behaviours towards humans. These contrasting scenarios illustrate how the same two species, humans and macaques, develop different co-cultural relationships based on their shared environment and interactions. This phenomenon of co-culture, reflecting varying degrees of pacifism or aggression, is not limited to Japanese macaques but is also evident in interactions between humans and other primate species, such as rhesus macaques and langurs in India, toque macaques and langurs in Sri Lanka, and baboons in Africa. These examples underscore the broader concept of human-wildlife coexistence in urban and anthropogenic environments, where shared behaviours and adaptations emerge from the ongoing interaction between species. These co-cultures are majority symbiotic coadaptations in our mind but can also be not symbiotic but negative as farmers and maize-stealing crows, tourists and bears or corvids [8].

- **Cooperative hunting**

The cooperative hunting between dolphins and humans exemplifies co-culture, where both species adapt behaviours for mutual benefit [23,24]. In this tradition, fishermen and bottlenose dolphins collaboratively catch mullet. Dolphins herd fish towards the shore, signalling fishermen to cast nets. This synchronisation boosts both species' foraging success, reflecting a shared understanding of hunting techniques. This practice has strengthened socio-economic and cultural ties between humans and dolphins. However, it faces threats from tourism and environmental changes, highlighting the fragile nature of this interspecies relationship. This dynamic showcases the potential of interspecies collaboration and the importance of preserving such unique relationships. The interactions between honeyguides and human hunters [25], cases of cultural cooperation between animal species such as wolves and ravens [26], preferential mixed bat species roosting [27], mixed species group

formation in callitrichine primates [28], and many other species combinations [29] demonstrate complex dynamics of interspecies collaborating and culturally adapting to each other's reactions and coactions over time.

— **Signal convergence**

Interspecies signal convergence, as described in the context of bird species [9,30] using similar acoustic signals in proximity, aligns closely with the concept of co-culture. In co-culture, different species develop concurrent and interrelated behaviours through direct or indirect interactions. The phenomenon of signal convergence among bird species represents a form of co-culture where interspecies communication networks extend beyond individual species boundaries, leading to clustered and synchronised signals. This may also occur in other species as tamarins [31]. This convergence indicates a deeper level of social communication that transcends species-specific boundaries, highlighting a form of co-cultural evolution. The birds' similar ecological niches and interactions drive this convergence, suggesting that instead of diverging to minimise interference, their signals have evolved to become more similar, effectively enhancing interspecies communication. This pattern contradicts the traditional view of signal divergence to avoid misidentification and represents a novel form of interspecies interaction and adaptation, a core aspect of co-culture.

Future research perspectives

- **Interspecies social learning**

Future research in interspecies social learning [1,6] is pivotal in understanding how species, including humans, mutually influence each other's learning and behaviours in shared environments. This field challenges the notion that learning is exclusively intraspecific, as evident in studies where birds and horses learn from other species, leading to behavioural adaptations and preferences that exemplify convergent evolution. For example, migrant flycatchers adopting habitat preferences from resident tits demonstrate increased interspecies habitat overlap. A form of solitary object play, stone handling, has been documented in Japanese macaques since its emergence in the mid-1970s, and is culturally transmitted among members in the group [32,33]. More recently, stone handling has been shown to occur under free-ranging and captive conditions in four geographically isolated macaque species (*M. fuscata*, *M. fascicularis*, *M. mulatta*, *M. cyclopis*) in the fascicularis subgroup [34,35]. A comparison of the stone handling behavioural patterns of 10 troops of Japanese macaques across Japan found intergroup variation in the number and types of behaviours exhibited [36]. At Takasakiyama Monkey Park, two closely situated, provisioned monkey groups exhibited the highest similarity in behavioural patterns, specifically in stone handling than combinations of the other groups studied. This behaviour primarily occurs post-feeding in open areas rich in stones. The significant number of shared behaviours between these groups, more than in others, is attributed to their proximity and daily opportunities for the subordinate group to observe the dominant group's stone handling post-feeding, thereby learning and adopting more of the same behaviours.

Under human-created conditions, the possible transmission of stone behaviour to a previously non-stone handling group of rhesus macaques from a stone handling group of Japanese macaques living adjacent to them has been reported [34]. Separated by a concrete wall with limited visual access, two monkey groups could partially see and hear each other. Observations revealed that when the Japanese macaques engaged in stone handling, the rhesus macaques, seemingly influenced by the sounds, began similar activities. A comparison showed high similarity in their stone handling behaviours. Despite the lack of direct contact, this artificial setup highlights the impact of visual and auditory stimuli in fostering shared cultural traditions between species. Human-animal interactions, like human-dog play [37] or human-horse communication [38], reveal co-cognitive processes emerging from collective interactions. All these examples help to elucidate the underpinning concept of co-culture.

- **Interspecies social networks**

The study of interspecies social networks aligns with the concept of co-culture by examining how different species, like humans and macaques, interact and adapt their behaviours within shared environments [39]. These interactions form complex social networks where each species influences and learns from the other, leading to shared patterns of behaviour, risk taking, and resource utilisation. This mutual adaptation and learning exemplify co-culture, where species co-evolve and co-create shared sociological spaces and networks [40]. These studies demonstrate that through social networks, interspecies relationships are not just incidental but are integral to the behavioural and ecological strategies fostering a dynamic, bidirectional exchange.

- **Urban animal cognition**

Studying urban animal cognition [3] in relation to co-culture involves understanding how animals adapt their cognitive abilities to thrive in urban environments, which are significantly different from their natural habitats. This adaptation is a part of the co-culture concept, where animals and humans mutually influence each other's behaviours and environment. Urbanisation presents unique challenges for wildlife, requiring animals to modify their behaviours, learning, memory, and problem-solving skills to navigate new threats and exploit novel resources. These cognitive adaptations are a response to the dynamic and often unpredictable urban landscapes. In the same way, humans adapt their urban environment to welcome or chase animals. Management-induced selection may significantly affect the adaptive or non-adaptive evolutionary processes of urban populations, yet few studies explicate the links among conflict, wildlife management, and urban evolution [41,42]. By adapting to human-modified environments and sometimes engaging with humans directly, urban animals demonstrate a co-cultural relationship, where their cognitive evolution is intricately linked to the human-shaped ecosystem. This interplay highlights the reciprocal effects and adaptive responses between humans and wildlife, central to the concept of co-culture.

- **Cultural and genetic coevolution**

The concept of co-culture, where both species involved evolve and change, offers a nuanced understanding of cultural and genetic coevolution (figure 1) [43]. In co-culture, both species

mutually influence and adapt to each other's presence, leading to joint evolutionary changes. This process reflects a bidirectional interaction, where the cultural behaviours and genetic traits of one species shape and are shaped by those of the other with feedback between both species. Such interactions result in shared adaptations that are beneficial for both species, underscoring a symbiotic relationship rather than one dominated by control. This perspective emphasises the collaborative aspect of domestication, viewing it as a co-evolutionary process rooted in mutualism, with both species playing active roles in shaping this dynamic evolutionary pathway. Co-culture extends and enriches Henrich's ideas about the collective brain and cultural evolution [44] as well as evolution of networks [40,45].

Conclusion

The exploration of co-cultures, highlighting interspecies culture among humans and animals, opens a transformative perspective on how different species co-evolve and mutually influence each other's behaviour and cognition. This concept challenges the traditional understanding of culture and learning as species-specific phenomena, emphasising the intricate dynamics of interspecies interactions in various contexts, notably in urban environments. This research underscores the significance of co-culture in understanding the dynamics of interspecies relationships, where behaviours evolve concurrently and mostly symbiotically, leading to novel nature-culture structures. The study of co-cultures is a frontier in understanding the interconnectedness of life, emphasising the need for further research in this field to unravel the complexities of these evolutionary processes and their implications for conservation, urban planning, and our broader understanding of animal cognition and behaviour.

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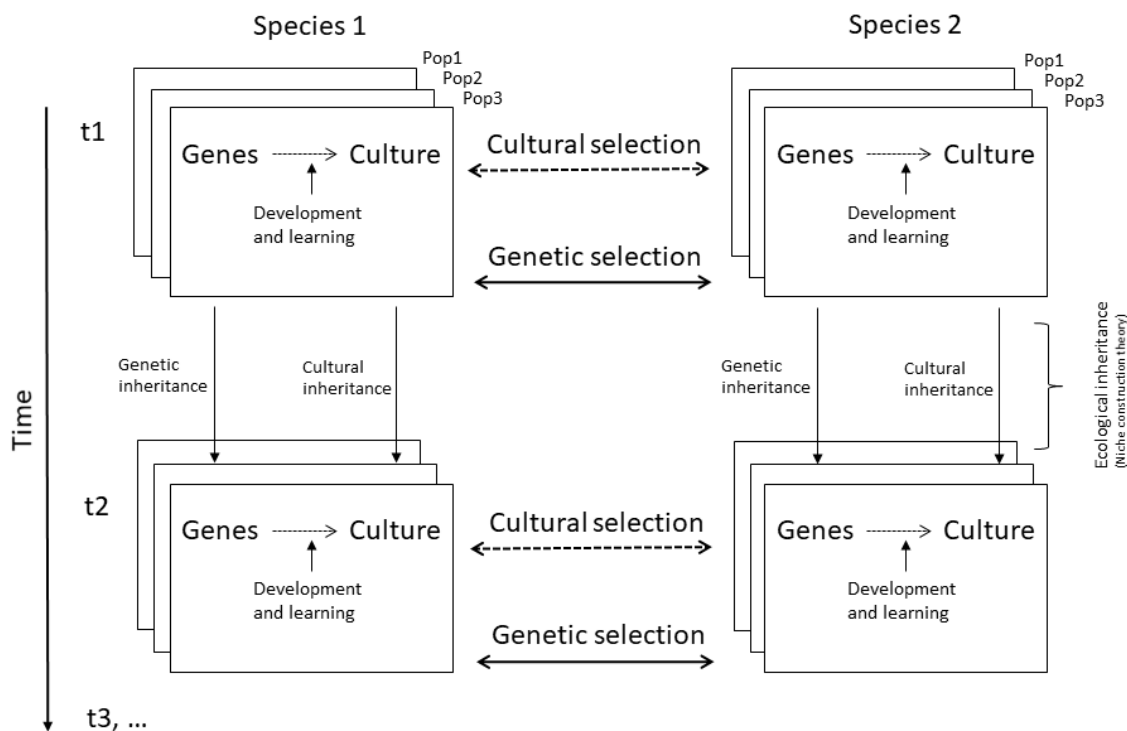


Figure 1: This figure presents an advanced model integrating gene-culture coevolution with niche construction concepts, demonstrating the genetic and cultural coevolution across multiple populations (Pop1, Pop2, Pop3, etc.) of two interacting species over time (t1, t2, etc.). Adapted from [8], it illustrates how a spectrum of phenotypes within a population results from a combination of genetic, individually acquired, and culturally learned information. The evolution of populations is depicted through the transmission of genetic and cultural information across generations. The interaction between Population 1 of Species 1 and Population 1 of Species 2 exemplifies the impact on both natural selection, affecting inclusive fitness, and cultural selection, influencing the cultural fitness of memes. These reciprocal interactions between species' populations can drive the coevolution of genes, showcasing the complex interplay of genetic and cultural factors in evolutionary processes.