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Animal Behavior: Ape Curiosity on Camera

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How animals respond to novel objects may reflect their overall cognitive and behavioral disposition. A study using camera traps reveals that different species of wild ape respond to novelty differently.

How animals react to novel situations, foods or objects reflects a balance between neophobia (novelty avoidance) and neophilia — the drive to approach and explore, in other words components of curiosity. As such, animals behave according to the costs and benefits of exploring something new, potentially dangerous. In a new study in this issue of *Current Biology*, Ammie Kalan, Hjalmar Kühl and colleagues [1] report the behavioral responses of wild chimpanzees, bonobos and gorillas to camera traps.

It is difficult to study reactions to novelty in the wild — usually this was thought to demand field experiments where one must be careful not to habituate wild populations, e.g. through food provisioning or through association with humans. Consequently, studies aiming to address curiosity should best avoid direct human observation. The use of video camera traps, applied by Kalan and colleagues [1], is a relatively non-invasive, yet effective approach to obtain genuine reactions to novel items in wild apes. Camera traps also enable researchers to address novelty responses with the great unknown — wild animals that are not habituated to humans. Kalan and colleagues [1] studied an impressive 43 different groups of the three African ape species distributed across 14 sites (Figure 1).

The authors found that the three species of African apes differed in their responses to a novel object: camera traps. Apes rarely touched the camera traps, which indicates that neophilia, or the motivation to explore, was low in all three species. Compared to chimpanzees, bonobos and gorillas were more likely to look at the camera traps. Bonobos were also the most neophobic species, producing more alarm calls and other fearful behaviors than the other apes. Overall, immatures looked towards camera traps the most and individuals in smaller parties looked at the camera traps for a shorter time than lonely apes. Apes showed less interest in camera traps the closer they lived to long-term research sites. As such the authors suggest environmental factors to reflect part of the site variation in responses. Moreover, the authors propose that the observed species differences in camera trap responses are due to variation in social structure, such as lack of clear leadership in bonobo communities contributing to increased neophobia in this species. Studies on novelty responses in wild primates are rare, and comparisons between species are so far lacking (but, see [2]), making the contribution of Kalan and colleagues [1] highly valuable.

Using camera traps as stimuli is a useful first step to determine how artefacts placed in nature affect wild ape behaviors. But one could argue that the (camouflaged) camera trap itself represents a relatively uninteresting novel object for wild apes. Accordingly, the authors report no real fearful behaviors (except a few bonobo alarm calls). Thus, the most common recorded responses — looking impulses — are best described as indifference rather than truly neophobic or neophilic. This highlights the importance of what kind of stimulus is used when assessing novelty response and explorative behavior [3,4]. However, using camera traps as stimuli has the advantage that it provides a stimulus that is consistent across different sites. Such a low degree of variation (in appearance) is generally not possible to achieve when humans (and their behavior) are the stimuli. Thus, while we also need to use multiple stimuli when we aim to assess curiosity, camera traps are still informative on how the presence of humans and our artefacts affect wild animals' behavior.

The study of Kalan and colleagues [1] nicely complements previous results reporting conservative behavior towards novelty in wild orangutans. Like African apes, wild orangutans mostly look at novel objects and only touch them in rare cases — after observing humans doing so — suggesting orangutans use social cues to overcome neophobia [5]. The study by Kalan and colleagues [1] also hints to within-species differences between captive and wild apes. Wild apes spend most of their wake time searching for food, mating partners, or shelter in natural habitats beset with risks. Consequently, for wild apes, curiosity can be much more costly than for their captive conspecifics, who benefit from a safer habitat and have more time to invest in exploration. This within-species discrepancy is referred to as the captivity effect [5–7] and explains the increased curiosity observed in captive housed apes [8]. The study by Kalan and colleagues [1] thus stresses the importance of studying curiosity in natural habitats, because solely captive data can generate a biased picture of ape curiosity. The between-species differences found by Kalan and colleagues [1] in wild apes, where bonobos showed the highest frequency of neophobic responses, match with some previous results from captivity, describing bonobos to be more risk averse than chimpanzees [9,10]. However, other studies on novel food response found that captive chimpanzees show similar food neophobia as bonobos and more than gorillas [11,12].

Kalan and colleagues [1] assume both large dietary variation and differences in innovative abilities across the tested species, as chimpanzees are the most proficient African ape tool users. Consequently, the authors expected chimpanzees to show higher neophilia

Figure 1. Gorilla on camera.
Nkombe, an adult female from the Atananga Group in Gabon, taking a break from feeding. Photo: Martha Robbins/Loango Gorilla Project.

than bonobos and gorillas, but in fact chimpanzees showed the least interest in the camera traps. This would suggest that neophilia is not solely responsible for innovation ability. In fact, it has been suggested that species with strong behavioral flexibility maintain a balance between neophobia and exploration tendency [13, 14], although the exact mechanism for this paradoxical combination is not yet fully understood. The 'social information hypothesis' predicts that long lived, large brained species — such as great apes — are influenced by social cues when deciding what in their environment to attend to, followed by individual learning of the characteristics of the socially discovered novel item [15]. That young individuals looked longer at camera traps, but did not necessarily touch them, suggests that young apes indeed showed interest in the novelty but simultaneously were too neophobic to interact with something new and potentially risky. Similarly, young apes are more cautious than adults to ingest novel food items [11,12]. It would be interesting to see whether young individuals would proceed with physical exploration of the camera traps if they would have witnessed adults interact with them first.

Using camera traps makes it hard to oversee the complete social situation, due to the limited field of view it is not always clear how many others are around. Camera traps focusing on other camera traps and their surroundings might help in such cases. It would be good to know whether any exploration event of the camera traps triggered other individuals to approach. Of course, sociality can have the opposite effect as well. In gregarious species individuals may be busy maintaining social bonds and keeping track of social events, which might hinder them to invest in individual exploration. This might explain why individuals included in the study by Kalan and colleagues [1] looked for a shorter time in social situations.

The 'dangerous niche' hypothesis [13] predicts that the level of neophobia echoes the risk level of the habitat. Quite the reverse was found by Kalan and colleagues [1], namely fewer neophobic responses in populations where hunting pressure was higher. This potentially reflects that individuals of such populations are more familiar with human artifacts (extending to camera traps). Furthermore, following the dangerous niche hypothesis, beyond human threats, there are likely to be more ecological hazards that could account for variation in novelty response between the different species and populations.

The study by Kalan and colleagues [1] draws attention to the fact that, so far, no single hypothesis can explain the variation in exploration tendency and neophobia in great apes. Ideally, future studies can disentangle environmental and social factors to clarify the relationship between exploration drive and neophobia and the conditions that elicit curiosity. Understanding curiosity in non-human primates will also shed light on the arguably extreme case of human exploration and innovation ability. Finally, natural habitats are fast changing due to human activity, causing wild populations to face new challenges. For species conservation purposes, it is now more urgent than ever to understand how different species react when faced with habitat modifications incorporating exposure to novelty.

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Evolution: The Battle of the First Animals

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Ctenophores or ‘comb-jellies’ are marine animals whose relationship to other phyla is uncertain, yet important for understanding major steps in animal evolution. Fossil ctenophores from the Cambrian indicate that ctenophores may have evolved from a sessile, cnidarian-like ancestor.

The origin and earliest evolution of animals has been the subject of open warfare in the natural sciences in recent decades. One important battlefield has been the unresolved relationship between five animal groups — ctenophores, cnidarians, placozoans, poriferans and bilaterians (essentially all other animals). This (phylogenetic) Battle of the Five Armies is as cacophonous and confusing as anything that Peter Jackson produced in recent years [1]. Yet an uneasy truce has recently emerged concerning the position of the sponges (Porifera), returning to the antebellum state with a monophyletic group of sponges at the base of animal evolution [2–5]. Otherwise, there is little resolution. These five animal groups are highly derived, with over 500 million years separating their origination from their modern anatomy. The ctenophores are particularly rogue and querulous, with their molecular sequence seemingly switching sides so often that its true allegiance is difficult to discern [6,7]. Fortunately, we also have fossils. These provide another tangible record of evolution and are particularly abundant and well preserved during the first major burst of animal evolution, the Cambrian explosion. A new study in this issue of *Current Biology* by Yang Zhao, Jakob Vinther and colleagues [8] describes bizarre Cambrian fossils and places them in the ctenophore stem lineage, forming a close alliance between ctenophores and cnidarians (Figure 1).

The fossils of the Cambrian explosion, found at sites such as Burgess Shale and Chengjiang, are renowned not only for their exquisite preservation of soft-bodied animals in fine anatomical detail, but also because of their enigmatic nature. The most famous of these are the ‘bizarre crab’ *Anomalocaris* and the ‘mind-bending’ *Hallucigenia*. The fossils described by Zhao and colleagues [8] are just as enigmatic, marking this work as an important contribution to the field owing to the detailed descriptions and images of a new taxon, *Daihua sanqiong*, and of enlightening new specimens of previously described taxa, including *Xianguangia*, *Dinomischus* and *Siphusauctum*. This last taxon has colloquially been called the ‘tulip animal’, which is a fairly accurate visual description of its overall anatomy [9]. The tulip-shaped body of *Siphusauctum* consists of a narrow stem topped by a rounded, bulbous main body chamber, which contains the mouth and gut, and is adorned with ‘petals’ represented by six radially-arranged tentacles covered in rows of hair-like protrusions, or cilia [8,9]. *Siphusauctum* was previously identified as a bilaterian but could not be placed in any specific phylum [9]. Another taxon that has yet to find a home in any animal phylum is *Dinomischus*, which is also tulip-like but has a sclerotized organic skeleton not found in the entirely soft-bodied *Siphusauctum* [9]. The new taxon *Daihua* and the previously described *Xianguangia* [10] are both stalkless, but have a sclerotized organic skeleton supporting an expanded body region with long tentacles bearing pinnules with rows of cilia [8]. *Xianguangia* had previously been placed in the stem lineage of Cnidaria [10].

By comparing these enigmatic fossil taxa with definitive ctenophores, the phylogenetic analysis of Zhao and colleagues [8] places *Xianguangia*, *Daihua*, *Dinomischus* and *Siphusauctum* in the stem lineage to ctenophores. The resulting scenario of evolution suggests that ctenophores originated from sessile benthic, sea anemone-like ancestors, with *Xianguangia* then *Daihua* branching off basally, followed by the stalked *Siphusauctum* and *Dinomischus*, before the evolution of pelagic ctenophores. This sequence of events requires numerous