



## Short report

## Possible tool use in a mountain gorilla

Cyril C. Grueter<sup>a,b,c,\*</sup>, Martha M. Robbins<sup>a</sup>, Felix Ndagijimana<sup>b</sup>, Tara S. Stoinski<sup>b</sup><sup>a</sup> Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany<sup>b</sup> Dian Fossey Gorilla Fund International, Atlanta, GA, USA<sup>c</sup> The University of Western Australia, Crawley, WA, Australia

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## ABSTRACT

Here we report a description of putative tool use in wild mountain gorillas. At the Dian Fossey Gorilla Fund's Karisoke Research Center in Volcanoes National Park (Rwanda), an adult female was observed using a bamboo culm as a ladder for her offspring. This is one of only a few documented cases of possible tool use in wild gorillas, although tool use behavior is commonly observed in captive gorillas. Although the behavior observed may have been incidental, the present report in combination with previous evidence (Breuer et al., 2005) suggests that tool use in gorillas occurs outside the context of food acquisition and may be directed at overcoming physical obstacles in complex rugged microhabitats such as bamboo forest and swamps.

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## 1. Introduction

The most influential definition of animal tool use is by Beck (1980, p. 10), "the external employment of an unattached environmental object to alter more efficiently the form, position, or condition of another object, another organism, or the user itself when the user holds or carries the tool during or just prior to use and is responsible for the proper and effective orientation of the tool". More recently, modifications of this definition have appeared in the literature, e.g. "using an object as a functional extension of [an animal's] body ... to act on another object or a surface to attain an immediate goal" (Fragazy et al., 2004). Tool use has been recorded in an ever increasing number of mammals and birds, most notably primates, dolphins and crows (reviewed in Bentley-Condit and Smith, 2009; Shumaker et al., 2011). Most reports of tool use in non-human primates come from chimpanzees, orangutans and capuchin monkeys, but other primates such as macaques have also been reported to use tools.

Tool use can occur in a variety of functional categories including self-care, exploration and communication (Fragazy et al., 2004), but most instances occur in a foraging context. Some of the best known examples of foraging-related tool use in primates include use of stones to open oyster shells in macaques (Carpenter, 1887), nut cracking with hammer and anvil in chimpanzees and capuchins (Boesch and Boesch, 1983; Moura and Lee, 2004), fishing for

termites with sticks in chimpanzees (Goodall, 1964), using tools to extract seeds from the protected fruits of *Neesia* sp. by orangutans (van Schaik et al., 2003), and using branches to extract bushbabies from tree cavities by chimpanzees (Pruetz and Bertolani, 2007). Examples of tool use also occur in non-foraging contexts, mostly to protect body parts from environmental elements, such as rain or sun, to promote hygiene or to use as part of a display (see, for examples by chimpanzees and orangutans, Lindshield and Rodrigues, 2009; van Schaik et al., 2003; Whiten et al., 1999).

Tool use is relatively infrequent in gorillas as compared to chimpanzees and orangutans, and most instances come from captive settings (reviewed in Parker et al., 1999; Shumaker et al., 2011), e.g. using sticks to extract food out of artificial and natural devices (Boysen et al., 1999; Pouydebat et al., 2005), throwing sticks to knock leaves and seeds out of the foliage of trees (Nakamichi, 1999), making primitive 'shoes' by holding straw in hands and feet when walking on snow (Nierentz, 2007), using buckets to collect water (Margulis et al., 2012), and using rakes to reach otherwise inaccessible food (Wood, 1984; Fontaine et al., 1995).

Observations of tool use in wild gorillas are extremely rare. Breuer et al. (2005) provided an account of a western gorilla adult female using a branch to probe the depth of water in a swampy clearing. In addition, they observed another female using a detached stem as a support structure during food preparation and later using the stem as a bridge to cross a swamp. Gorillas also engage in displays in which they use external objects such as water (Parnell and Buchanan-Smith, 2001) or vegetation (Emlen, 1962; Groves, 1970; Schaller, 1963; Wittiger and Sunderland-Groves, 2007). These may or may not qualify as tool use as defined in earlier in the paper. Here we report an observation in a wild mountain gorilla that appears to meet the requirements of tool use, but given

\* Corresponding author at: School of Anatomy, Physiology and Human Biology, The University of Western Australia, Crawley, WA 6009, Australia.  
Tel.: +61 8 64888643.

E-mail address: [cyril.grueter@uwa.edu.au](mailto:cyril.grueter@uwa.edu.au) (C.C. Grueter).



**Fig. 1.** Infant gorilla Imbuto using a bamboo pole held by his mother for climbing. (a) Infant is ca. 1 m above ground, (b) infant is ca 1.5 m above ground.

the anecdotal nature of the observation, extrapolation and generalization is not possible unless more reports become available.

## 2. Methods

Since 1967, a subsection of the mountain gorilla population living in the Volcanoes National Park (Rwanda) has been monitored by the Dian Fossey Gorilla Fund's (DFGFI) Karisoke Research Center. The habitat of the gorillas comprises a mosaic of open herbaceous fields, woodlands and afroalpine floral communities on the slopes of dormant volcanoes (McNeilage, 2001). The gorillas' resource base consists primarily of non-seasonal herbaceous leaves and stems, complemented with seasonally sprouting bamboo shoots (McNeilage, 2001; Watts, 1984).

Daily demographic, behavior and ranging data are collected on each of the groups monitored by the DFGFI staff, and complete lifetime demographic information exists for ~95% of the population. The current observation was made in Pablo's group ( $N=45$  gorillas) during a study focusing on feeding ecology. All gorillas in the group are individually identified through distinctive nose print patterns.

## 3. Results

On November 30, 2010, Group Pablo was in the bamboo zone at an altitude of ca 2800 m. Nutrient-rich bamboo shoots are available twice per year, at which time the bamboo zone constitutes the gorillas' preferred foraging grounds. The vegetation in the bamboo zone is characterized by dense thickets of *Yushania alpina* interspersed with some open herbaceous fields.

At 09:09, adult female Tamu was sitting ca 2–2.5 m above the ground on a thicket of bamboo and herbaceous plants where she was feeding. At 09:10, her infant Imbuto (age 12 months) was seen walking on the ground in the direction of his mother and was uttering distress vocalizations. Immediately after the vocalizations, Tamu became alert and stopped feeding. The infant met its mother's gaze when he was ca. 4 m from the bamboo thicket. He moved to the base of the bamboo thicket and attempted to climb up by grasping herbaceous/shrubby vegetation, which repeatedly became dislodged from the pile by the infant's weight. The only

item providing reasonably firm support was a hard bamboo shoot that Tamu had detached a few minutes before. At 09:11, Tamu was in a sitting position and holding one end of the bamboo pole, which hung vertically to nearly the bottom of the vegetation pile. The infant grasped the pole, at which time the mother repositioned herself by turning ca 45 degrees in the direction of the infant, bending over the edge and looking at the infant. She then held the pole firmly with one hand (without adjusting the angle or position of the pole), which permitted the infant to climb up as one would do on a ladder (Fig. 1). She carefully observed the infant during the climbing process. After the infant had reached the top of the pile and was reunited with his mother, the mother did not resume her feeding activities, but started resting instead.

## 4. Discussion

This paper presents a description of another case of putative tool use in wild gorillas, which involved a female mountain gorilla using a bamboo pole to help her infant overcome a physical obstacle. In the case documented here, the mother did not specifically detach and prepare the bamboo pole to be used as a tool for her infant. The bamboo pole presumably had been originally harvested for the purpose of consuming it. This suggests that the subject exhibited flexibility with regards to how she perceived the physical environment and reinterpreted the functionality of the item after being presented with a key stimulus, i.e. seeing her infant in distress and unable to climb a vegetation pile to reach her. An alternative explanation that involves less intentionality and empathic perspective-taking of the mother would be that she simply happened to have the pole in her hand when looking down at the climbing infant. However, she seemed to hold the pole more firmly when the infant grabbed it, implying that she was aware of the functionality of the item and the intention of the infant. This latter claim is admittedly based on subjective evidence, so more observations of similar events are needed to substantiate this hypothesis. Yet another alternative explanation is that the female used the bamboo pole as a stabilizer for herself while leaning over to observe the climbing infant, which would also constitute tool use.

Compared to chimpanzees, which are renowned for exhibiting a wide repertoire of tools in their natural habitats (McGrew,

1992; Whiten et al., 1999), tool use is notoriously rare in wild gorillas, but has been repeatedly observed in captive western lowland gorillas (Herrmann et al., 2008; Mulcahy et al., 2005). Additionally, one of the other observed instance of tool use in wild gorillas involved overcoming a physical barrier (Breuer et al., 2005), which is quite different from chimpanzees where a significant proportion of observed tool use behaviors are related to obtaining food. Lack of documented cases in gorillas may well indicate observational constraints compared to other species; especially chimpanzees which have been the subjects of long-term research at many sites, whereas there are fewer long-term field sites for gorillas. There are sites where chimpanzees do not use tools and so if studies had been limited to those areas, we might incorrectly assume that chimpanzees are not tool users. However habituated gorillas have been observed for more than a decade at each of four study sites (two mountain gorilla and two western gorilla sites) so the lack of more observations of tool use does not seem to be due only to limited observation time.

Even though mountain gorillas have been extensively observed for four decades under excellent observation conditions, no food related tool use has been seen. van Schaik et al. (1999) argued that the reliance on extractive foraging acts a key driver for the development of manipulative skills needed for tool use to obtain food. As compared to chimpanzees, the mountain gorilla's heavy reliance on herbaceous vegetation requires significantly less extractive foraging, although hidden food items (e.g. roots, pith) do comprise a notable portion of their diet (>10% of biomass of total diet) (McNeillage, 2001), and captive gorillas engage in extractive foraging (Boysen et al., 1999; Pouydebat et al., 2005). Thus, a more probable but still speculative reason is that the physical strength of gorillas in combination with their lack of reliance on extractive food sources allows them to access most of their diet, even those items that need to be extracted, by brute force, thus making delicate tool use obsolete (Breuer et al., 2005; van Schaik et al., 1999). For example, whereas chimpanzees use tools to access termites, western gorillas simply break off part of the mound (Cipolletta et al., 2007).

With a few examples of tool use in wild gorillas and multiple examples in captivity, it is evident that gorillas are capable of tool use. Moreover, species such as gorillas that have high levels of 'sociability' in their cohesive groups would seem prone to develop sophisticated cognitive capacities because this sociability promotes innovation and skill transmission (van Schaik and Pradhan, 2003; van Schaik et al., 1999). Although the need for tool use in the foraging domain may be limited (see above), tool use may be advantageous in other contexts. The fact that one previous observation of tool use in wild gorillas (Breuer et al., 2005) was related to conquering physical obstacles in their natural habitat leads us to tentatively propose that complex microhabitat features could influence the need to use tools in the context of moving and could trigger innovative material behavior in this context. However, given the paucity of observations, further research is required to establish the existence and context of tool use in wild gorillas.

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