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Short report

Observation of tool use and modification for apparent hygiene purposes in a mandrill

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ABSTRACT

Tool making or modification to produce a tool of apparent improved functionality has rarely been reported in monkeys, especially when tools are used outside the context of food acquisition. We report on an observation of selection, modification and use of splinters for hygiene purposes in a male mandrill. The zoo-housed animal was video-recorded breaking splinters in sequence to use them underneath his toe-nails. This record brings forward new evidence that the ability to use and modify tools is not limited to apes and some New World monkeys but is also apparent in Old Word monkeys.

1. Introduction

The use of tools by non-human primates is receiving considerable attention as it throws light on the evolution of our own cognitive abilities (Tomasello and Call, 1997). Following St Amant and Horton (2008), we define tool use as the exertion of control over a freely manipulable external object (the tool) with the goal of (1) altering the physical properties of another object, substance, surface or medium (the target, which may be the tool user or another organism) via a dynamic mechanical interaction, or (2) mediating the flow of information between the tool user and the environment or other organisms in the environment. Observations both in the wild and in the captivity have shown that a number of primate species are able to use tools, largely in feeding contexts (for reviews see Beck, 1980; Tomasello and Call, 1997; van Schaik et al., 1999). However, the more complex modification and manufacture of objects to make tools more suitable for a particular function has been found far less frequently (Leca et al., 2010; Lindshield and Rodrigues, 2009; Ritchie and Fragaszy, 1988; Sinha, 1997; Thierry et al., 1994; van Schaik et al., 1999; Watanabe et al., 2007). Tool modification is defined here as separating the tool from its substrate and giving it a new shape for its subsequent use (Beck, 1980).

The development of tool use may not necessarily require planning, if accidental discoveries lead to the habitual application of tools through conditioning; e.g. with obtained food as a reward (van Schaik et al., 1999). With tool manufacture accidental discoveries are less likely because of the higher complexity of the process; it occurs in two steps, firstly tool manufacture, and secondly its application. Tomasello and Call (1997), for instance, argue that mental representations are required for the manipulation and application of tools to solve particular problems. Many tool applications, especially those that do not involve food, are more likely to be discovered in captivity where individuals have more time as a consequence of being provided with sufficient food and other requirements such as shelter.

Largely in feeding contexts, tool modification or manufacture in monkeys has been reported in the genera *Macaca*, *Cebus* and *Papio* (van Schaik et al., 1999). Outside of feeding, but in a specific hygiene context, tool manufacture has been observed in *Cebus* (e.g. Ritchie and Fragaszy, 1988), *Macaca* (Sinha, 1997; Thierry et al., 1994), and recently in *Ateles* (Lindshield and Rodrigues, 2009). The former observations all involved breaking sticks, and the latter study of spider monkeys was done under wild conditions. Hairs used as dental floss after a bout of hair plucking in long-tailed macaques has been argued to be tool modification (Watanabe et al., 2007) although this may not fall within the definition of tool modification. Leca et al. (2010) found mixing of hair with saliva for the same purpose and this could be argued to fall within the definition.

Specifically for mandrills, comparative experimental work by Westergaard (1988) did not find the ability to use or manufacture tools. Vincent (1973) however, did find that a captive mandrill used grass stems and sticks to clean an infected ear, but in this case there was no modification of grass or sticks when used for this purpose although the items were selected according to length and rigidity. Thereafter, a number of observations have reported cercopithecoids, but not mandrills, handling sticks for scratching purposes

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(Galat-Luong, 1984): here too, no modifications were made prior to use.

This report shows the ability of tool use and modification by an individual mandrill.

2. Methods

The group of six mandrills (*Mandrillus sphinx*) was housed in the 'Monkey Islands' exhibit at Chester Zoo, England. The animals lived in an indoor enclosure connected to an outdoor area comprising an artificial island, totalling about 1140 m^2. The indoor enclosure measured 19.5 m × 10 m × 5 m and the front side of the cage consisted of glass, allowing viewing by the zoo visitors. The indoor part was furnished with tree branches, ropes and strings hanging from the ceiling, logs and other enrichment components to allow for diverse behaviours and climbing. The floor of this section was covered with bark, sticks, twigs, and wood chips.

The adult male, named JC, on whom we report here, was born at Usti Zoo in Czech Republic in 1992 and moved to Chester when young. JC was 12 years old at the time of this study and was alpha male within his social group.

In addition to recording behaviour through scan sampling, we collected video-recordings of the mandrills. We recorded observations in March, April and May 2005, on 42 days, during the 6 h of opening time of the zoo. For the whole study period all-individual scan samples were recorded every 5 min. The ethogram included detailed behaviours broadly categorised in feeding, resting, locomotory, and social. In addition to scan samples, focal samples of each individual were taken in random order. A total of 37 videos (with a duration of 25 min each) were collected at arbitrary times by means of video camera (a Sony MiniDV model with 33× optical zoom). Six of these videos focussed on the dominant individual. The peculiar tool handling behaviour was recorded during one such video in May.

The mandrills showed a variety of natural behaviour patterns, as well as some repetitive behaviour such as hair plucking (Pansini, 2006). The alpha male was observed to manipulate the fine substrate material (bark, wood chips and splinters) on the cage floor. During 42 days and over 250 h of data collection, seven scans of handling of this small substrate material were recorded for this individual (Pansini, 2006), although not all were within a tool use context. This handling behaviour represented 0.26% of the total activity budget of this male during all observations.

3. Results

In one of the seven handling sessions observed, the mandrill was recorded on a 4-min video clip (an extract of 3 min reported in Video 1) whilst sitting on the bark and wood chip littered floor surface, 8 m away from the display window. This allowed us to make a detailed analysis of his tool use behaviour.

The animal was observed to perform the following series of actions:

(a) picked up twigs from the ground 7 times, choosing some of them through a process of selection and elimination (Fig. 1A);
(b) manipulated and broke some of these twigs (at least three of the seven were broken) with the result of forming smaller splinters and achieving pointier tips (Fig. 1B). Of these broken sticks, two were put in the mouth and three were splintered using the left hand. The twigs were pushed against the right foot, thus breaking them;
(c) used the twigs to clean underneath the toenails of one foot whilst continuing to manipulate and splinter some of these twigs (Fig. 1C).

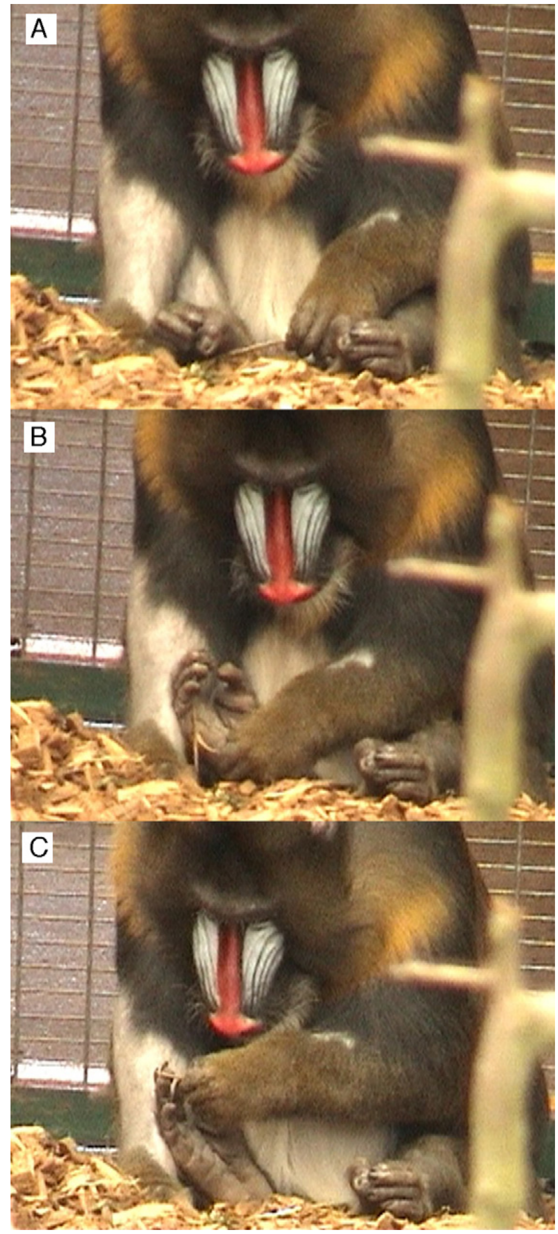

Fig. 1. The mandrill tool manufacturing behaviour in sequence. A – TOOL ACQUISITION: the animal picks up sticks from the wood bark floor seven times. B – TOOL MODIFICATION: three of these sticks are broken to produce splinters with pointier tips. C – TOOL USE: the modified sticks are used for seemingly cleaning purposes of the mandrill's right foot toenails, whilst at times keeping on splintering the sticks.

On two occasions the alpha male acted in a similar way, but instead of wood splinters he used his own plucked hair to clean his nails (reported in a video of 26 s, see Video 2).

4. Discussion

This observation shows the ability of a captive mandrill to use small wood splinters as tools. We interpret his continuous splintering of the twigs as an indication that the animal reshapes the tools to make them more suitable for his action, and the need of splinters as old ones become worn through usage. The behavioural sequence of using and modifying was performed in a fluid manner and in succession, suggesting intentionality and an attempt to achieve results by repeatedly improving the tools for seemingly cleaning purposes.

We do not know in which way the captive status of this mandrill might have affected the development of the tool use and modification reported here, but it is conceivable that it partly resulted from having more time to develop novel behaviours due to being provisioned without the need to find food.

Compared to the previous instances of tool manufacture in hygienic contexts, this mandrill manipulated sticks in a manner similar to that reported for capuchin monkeys (Ritchie and Fragaszy, 1988), macaques (Sinha, 1997; Thierry et al., 1994), and spider monkeys (Lindshield and Rodrigues, 2009). The different sequences of actions were distinct and clear, similar to those described for capuchin monkeys (Ritchie and Fragaszy, 1988).

These observations add to the growing record of tool-related behaviour. Although additional observations are now required in order to confirm our findings, mandrills are now a candidate species to be included in the list of animals capable of both using and modifying tools. These observations lead to the conclusion that there are fewer grounds for a systematic distinction between apes and Old World monkeys with regard to their ability to use and modify tools.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.beproc.2011.06.003.

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