

BRIEF REPORT

Invention and Modification of a New Tool Use Behavior: Ant-Fishing in Trees by a Wild Chimpanzee (*Pan troglodytes verus*) at Bossou, GuineaSHINYA YAMAMOTO^{1*}, GEN YAMAKOSHI², TATYANA HUMLE¹, AND TETSURO MATSUZAWA¹¹Primate Research Institute, Kyoto University, Inuyama, Aichi, Japan²Graduate School of Asian and African Area Studies, Kyoto University, Kyoto, Japan

Wild chimpanzees are known to have a different repertoire of tool use unique to each community. For example, “ant-dipping” is a tool use behavior known in several chimpanzee communities across Africa targeted at driver ants (*Dorylus* spp.) on the ground, whereas “ant-fishing,” which is aimed at carpenter ants (*Camponotus* spp.) in trees, has primarily been observed among the chimpanzees of Mahale in Tanzania. Although the evidence for differences between field sites is accumulating, we have little knowledge on how these tool use behaviors appear at each site and on how these are modified over time. This study reports two “ant-fishing” sessions which occurred 2 years apart by a young male chimpanzee at Bossou, Guinea. Ant-fishing had never been observed before in this community over the past 27 years. During the first session, at the age of 5, he employed wands of similar length when ant-fishing in trees to those used for ant-dipping on the ground, which is a customary tool use behavior of this community. Two years later, at the age of 7, his tools for ant-fishing were shorter and more suitable for capturing carpenter ants. This observation is a rare example of innovation in the wild and does provide insights into problem-solving and learning processes in chimpanzees. *Am. J. Primatol.* 70:699–702, 2008. © 2008 Wiley-Liss, Inc.

Key words: chimpanzee; tool use; ant-fishing; innovation; tool modification; Bossou

INTRODUCTION

Chimpanzees (*Pan troglodytes*) use tools habitually. Behavioral differences in tool use aimed at catching ants between different communities have been suggested to represent cultural variation [McGrew, 1992; Whiten et al., 1999]. “Ant-dipping,” a tool use aimed at capturing driver ants (*Dorylus* spp.) on the ground, has been observed at Gombe National Park, Tanzania [Goodall, 1986], and Taï Forest, Côte d’Ivoire [Boesch & Boesch, 1990], whereas this behavior has never been reported at Mahale, Tanzania. In contrast, “ant-fishing,” which is aimed at carpenter ants (*Camponotus* spp.) in trees, has primarily been observed among the chimpanzees of Mahale [Nishida, 1973]. At Bossou, Guinea, before 2003, we regularly observed ant-dipping but never ant-fishing [Sugiyama et al., 1988; Yamakoshi, unpublished], although both driver ants and carpenter ants are readily available at this site.

Several studies have investigated differences in tool use repertoire between field sites [e.g. Whiten et al., 1999] and social transmission of tool use behaviors [e.g. Hirata & Celli, 2003; Whiten et al., 2005]. However, we have little knowledge of how such tool use behaviors appear at each site and how these are modified over time. Here, we report two cases of ant-fishing at Bossou, a tool use never observed before at this site in spite of 27 years of

observation. This study aims (1) to provide a detailed description of ant-fishing by a Bossou chimpanzee; and (2) to discuss the process of innovation and modification of a new tool use behavior.

METHODS

Our chimpanzee (*P. troglodytes verus*) study group of Bossou is located in southeastern Guinea, West Africa, 7°39’N and 8°30’W. Since 1976, all individuals have been identified and habituated to human observers [Matsuzawa, 2006; Sugiyama, 2004; Sugiyama & Koman, 1979]. Research at this

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*Correspondence to: Shinya Yamamoto, Primate Research Institute, Kyoto University, 41 Kanrin, Inuyama, Aichi 4848506, Japan. E-mail: syamamoto@pri.kyoto-u.ac.jp

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site is almost year-round, and involves daily follows from nest to nest.

Ant-fishing in trees was first observed by G. Y. in March 2003, and then by S. Y. in January 2005. The behavior in both cases was recorded on videotape, supplemented by direct observation and ad libitum recording of the behavior. The chimpanzee observed fishing ants in both instances was a juvenile male (named JJ, 5 years 4 months old as of March 2003). Ant-dipping on the ground is customary at Bossou [Humle & Matsuzawa, 2002; Sugiyama, 1995; Sugiyama et al., 1988; Yamakoshi & Myowa-Yamakoshi, 2004]. The chimpanzee, JJ, was also observed dipping ants by T. H. in 2003 and by T. M. in 2005.

Several studies provide definitions of “ant-dipping” and “ant-fishing” [e.g. McGrew, 1974; Nishida et al., 1999]. Based on these, “ant-dipping” was defined here as a tool use behavior for catching driver ants on the ground, and “ant-fishing” as a tool use behavior for catching carpenter ants in trees. A bout was defined as a sequence of behavioral components that begins with the insertion of a tool into the entrance of an ant’s nest and ends with either the ingestion of ants (successful bout) or the cancellation of the sequence (unsuccessful bout).

After the observations, we collected the tools used by JJ, and the ant species he had fished or dipped for subsequent identification. We used *t*-tests for two independent samples for the comparison of tool length. The level of statistical significance was set at 0.05. Samples of ants were identified to the species level by several ant specialists: Dr. B. Taylor (for driver ants collected in 2003), Mr. B. Bolton (for carpenter ants collected in 2003), and Dr. S. Yamane (for all ants collected in 2005, based on previously identified specimens). This study complies with the ASP (American Society of Primatologist) principles for the ethical treatment of nonhuman primates and was approved by the relevant national authorities in Guinea where the research was conducted and by the Primate Research Institute of Kyoto University.

RESULTS

We observed two cases of a chimpanzee’s (JJ) ant-fishing behavior in trees at Bossou, one in 2003 and the second in 2005, while following the chimpanzees in the forest. The target ant species was arboreal carpenter ants (*Camponotus brutus*).

The first observation was as follows: on March 6, 2003, G. Y. found JJ (5 years 4 months old at the time) fishing carpenter ants nesting in a hollow in a tree trunk (*Carapa procera*) 3 m above the ground (Fig. 1A). This tool use session lasted for 12 min 59 sec. In this case, 14 bouts were observed. JJ successfully captured and consumed ants in 3 of the 14 bouts. In each successful bout, JJ held the wand with one hand, swept the wand directly with his lips, and ate approximately three ants. JJ held the wand



Fig. 1. JJ’s ant-fishing in the trees. (A) Ant-fishing first observed when JJ was 5 years 4 months old in 2003 (photo by G. Y.). JJ used a long and rigid tool that is similar to tools used for ant-dipping on the ground. (B) Ant-fishing with a short tool when JJ was 7 years 2 months old in 2005 (photo by S. Y.).

with his right hand in 13 out of the 14 bouts. In 11 bouts, the wands were held between JJ’s thumb and the side of his index finger, and in the other 3 bouts, they were held in his palm and fingers. JJ was observed shaking some ants off the wand once and sweeping them off twice. JJ was bitten by ants three times. When bitten, it seemed painful and JJ dropped the wand each time.

Two years later, on January 4, 2005, S. Y. found JJ (7 years 2 months old at the time) fishing for carpenter ants nesting in a hollow in the trunk of a tree (*Pseudospondias microcarpa*) 8 m above the ground (Fig. 1B). His ant-fishing lasted approximately 7 min, and three bouts for 3 min 57 sec were video-recorded. JJ succeeded in one of the three bouts in eating approximately three ants. S. Y. witnessed an additional successful bout before filming the behavior. During this observation, JJ was never bitten by the ants and held the wands between his thumb and the side of his index finger of his left hand.

The tools used by JJ at age 7 for ant-fishing in the tree were significantly shorter than those he used for ant-fishing at age 5 (Table I). At age 5, JJ used wands of similar length for both ant-fishing in the tree and ant-dipping on the ground. In contrast, the

TABLE I. Length of Tools Used by the Chimpanzee (JJ) for Ant-Fishing in the Trees and Ant-Dipping on the Ground

Tool length	Age	
	5 Years 4 months	7 Years 2 months
Ant-fishing	Mean = 33.7 cm <i>n</i> = 5 Range: 26.0–38.1 cm	Mean = 16.4 cm <i>n</i> = 3 Range: 11.9–19.5 cm
Ant-dipping	Mean = 42.8 cm <i>n</i> = 9 Range: 29.3–59.0 cm	Mean = 42.3 cm <i>n</i> = 4 Range: 28.3–59.5 cm

t-Test (two-tailed): Ant-fishing tools used in 5 years old (2003) were significantly longer than those used in 7 years old (2005): $t = 4.82$, $P = 0.0029$. Ant-fishing tools used in 5 years old were not significantly different from ant-dipping tools used in 5 years old: $t = -1.90$, $P = 0.081$. Ant-fishing tools used in 7 years old were significantly shorter than ant-dipping tools used in 7 years old: $t = -3.20$, $P = 0.024$. Ant-dipping tools used in 5 years old were not significantly different from those used in 7 years old: $t = 0.08$, $P = 0.93$.

wands used for ant-fishing at age 7 were significantly shorter than those he had used for ant-dipping during the same period. The wands used for ant-fishing at age 7 were also significantly shorter compared with the community average wand length of 50 cm recorded for ant-dipping [53.7 cm, Humle & Matsuzawa, 2002; 46.7 cm, Sugiyama, 1995]. The detailed analysis of the video-recorded ant-fishing at age 7 shows that JJ had shortened at least one of the three wands during use.

DISCUSSION

In Bossou, before these two cases, we had never observed ant-fishing in trees, although we had been carrying out almost year-round research, following the chimpanzees practically daily from nest to nest for 27 years earlier [Matsuzawa, 2006; Sugiyama, 2004; Sugiyama & Koman, 1979]. In addition, we never witnessed the immigration of a chimpanzee into the community during this period. Taken together, this suggests that JJ innovated this tool use behavior.

When JJ invented this new tool use behavior, he seemed to apply an “ant-dipping” tool and the technique to ants in the trees. This happened after the subject was already successful at dipping ants on the ground. The length, as well as the thickness and the rigidity, of the wands used by JJ at age 5 for ant-fishing was similar to that of the wands he used for ant-dipping at the same period. At this age, chimpanzees are highly motivated in using tools and learning and practicing tool use skills [Biro et al., 2003; Matsuzawa, 1994]. The motivation to use tools may not only encourage young chimpanzees to socially learn transmitted tool use behaviors but may also lead them to innovate new tool use behaviors through individual exploration and trial and error learning.

JJ made and used significantly shorter tools for ant-fishing in 2005 than in the first case in 2003. It is possible that JJ learned the characteristics of the target ants and modified appropriately the length of the tools during his subsequent performance. Although our observations of ant-fishing are too few to precisely discuss the evolution of this novel behavior over time, we do note a potential change in tool length. The length of the wands for ant-dipping is significantly influenced by the characteristics of the target ants [Humle & Matsuzawa, 2002]. There is a significant difference in gregariousness between driver ants and arboreal carpenter ants. Although carpenter ants climb up the wand in small numbers (2–4 ants per bout), driver ants often cling together on a wand, while also climbing up in great numbers [39–64 ants per bout in the field experiment; Humle & Matsuzawa, 2002]. In order to catch highly gregarious driver ants, long and sturdy wands are most suitable, whereas in order to catch less gregarious carpenter ants, short, more readily maneuverable wands may be more suitable. JJ used less suitable long wands at age 5 for ant-fishing, when he innovated the behavior, than later on at age 7. At age 5, with the long wands, JJ succeeded in eating carpenter ants in 3 out of 14 bouts (21.4%) and was bitten by ants three times. At age 7, with the short wands, he succeeded in eating the ants in one out of three bouts (33.3%) and was never bitten by the ants. These observations offer the possibility that the shorter tools used at age 7 were more suitable for ant-fishing, although we cannot robustly confirm this pattern based on such a small sample size.

This study presents the invention of a new tool use behavior, and suggests the modification of the newly invented tool use by a wild chimpanzee. We do not yet know whether this novel tool use behavior will disappear or spread among other members of the community. Future observations of ant-fishing at Bossou will help further understand the mechanism of innovation and social propagation of tool use behaviors in wild chimpanzees.

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