Tool Use by Captive Pigtailed Macaques

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ABSTRACT. A group of pigtailed macaques was given the opportunity to use a rod to reach otherwise unavailable food. Initial solution by one group member resulted from trial and error but subsequent solutions by others were accelerated by three types of observation learning: social facilitation, stimulus enhancement, and imitative copying. The greater capacity of macaques for observation learning may explain the greater incidence of tool behavior and subcultural phenomena among macaques than among other cercopithecines.

INTRODUCTION

Previous experiments have demonstrated that baboons of two species can learn, by individual trial and error, to use a tool to get food. However, despite prolonged opportunity to observe a skilled tool user, other baboons do not imitate the behavior and do not even acquire enough information to accelerate their own mastery of the task (Beck, 1972, 1973a, b). This is unexpected since other cercopithecines, most notably macaques, are capable of observation learning (Darby & Ripoelle, 1959; Itani & Nishimura, 1973; Kawai, 1965; Kawamura, 1959; Meyers, 1970; Stephenson, 1967). The behavior acquired by the macaques was not tool use; it may be that baboons are as capable of observation learning as macaques but that tool use is more difficult to learn by observation. Alternatively, baboons may be less capable of observation learning than the closely-related macaques. To resolve this question, the same tool task which had been presented to the baboon groups was presented to a small captive group of pigtailed macaques (Macaca nemestrina).

SUBJECTS AND METHOD

An established family group of seven experimentally naive individuals was used:

M1: A fully mature male estimated to be about 15 years old at the time of the experiment.
F1: A fully mature female also estimated to be about 15 years old. She was pregnant during the experiment. M1 and F1 are the parents of the remaining group members.
F3: A young adult female born 21 July 1970. She first showed estrous swelling on 22 October 1973 but, despite frequent copulation with M1 during subsequent cycles, she had not yet conceived at the time of the experiment.
F2: An adult female born 21 January 1969. She first showed estrous swelling on 7 August 1972. She had two infants (neither of which survived) by M1 prior to the experiment and was pregnant during the experiment.
M2: A juvenile male born 29 July 1971.

The animals are listed in the order of dominance as derived from 2445 minutes of observation of agonistic behavior prior to the experiment.

The group was housed in a 356 × 183 × 239 cm cage in the Primate House at the Chicago Zoological Park. The cage walls were constructed of gunite, the floor of terrazzo, and the top and front of metal bars. The cage contained shelves and a simulated tree branch. The animals' basic diet was commercial monkey chow and oranges, supplemented periodically by other fruits, vegetables, seeds, and live crickets. Water was provided ad lib.

The experiment was conducted between 1300 and 1530 hours on 42 days between 30 October and 28 December 1974. A black wooden platform, 183 cm wide and 152 cm deep, was erected outside of the cage, perpendicular to the cage front at the level of the cage floor. The tool, an “L”-shaped rake fashioned of 1/4 inch (.635 cm) threaded steel rod, was attached1) to the cage bars by a chain. The bent hook of the tool was 11.5 cm long, the shaft 84 cm long, and the chain 81 cm long. An aluminum pan, 22.9 × 12.7 × 6.4 cm, filled with a variety of highly preferred food, was placed on the platform 48 cm from the cage bars. This was 5 cm beyond the farthest extent of reach of any group member and well within reach, with the aid of the tool, of all group members. The tool was placed on the platform, between the cage and the food pan, so that the shaft formed a 30° angle in regard to the cage front and the hook pointed back toward the cage. The animals were then given access to the display. No training or shaping was used.

Each trial was timed, to the nearest second, from the time of presentation to the time the pan was secured. The animals directly involved in solution were noted and qualitative aspects of solution behavior were described. Prior to solution, all tool-related behavior was recorded, and animals touching the tool during five second time samples taken every five minutes were noted. Animals hitting the pan with the tool were also recorded.

This apparatus and these procedures are virtually identical to those used for the baboon experiments, thus permitting comparison of the tool behavior of the three groups.

As noted above, observation learning was a principal focus. Following HALL and Goswell (1964) and SPENCE (1937), I have delineated three types of observation learning (Beck, 1974, in press). The simplest, known as social facilitation, is simply increased readiness of an observer to perform a response when a conspecific performs the same or similar response. Another, called stimulus enhancement, is a change in the orientation of an observer’s behavior toward stimuli associated with previous

1) My definition of tool use (Beck, in press) stipulates that a tool be free of any fixed attachment to the substrate. In this experiment, the tool is attached merely to reduce the chance of animal injury or cage damage which could well occur if tool manipulation were not restricted. Since the attachment keeps the tool in the general vicinity of the problem display, it undoubtedly accelerates solution. Otherwise it has little effect on the dynamics and topography of solution behavior, thus solution can justifiably be called tool use.