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Responses to Novel Foods in Captive Chimpanzees

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Hesitancy to eat novel foods hampers the immediate enlargement of the diet but serves to limit the risk of ingesting toxic foods. Neophobia has been systematically investigated in only a few primate species, in which it appears to be affected by social influences. Surprisingly, little is known about neophobia in chimpanzees. We studied the response of eight adult captive chimpanzees to 16 foods (foods commonly eaten by humans and never tasted before by chimpanzees). Each novel food was presented twice to the chimpanzee by a familiar or an unfamiliar human. Between the two trials the human ate the food face to face with the chimpanzee (demonstration). Results showed that some foods were almost unanimously accepted, whereas others were not. Moreover, there were marked interindividual differences in food acceptance and consumption; chimpanzees ranged from being almost completely neophobic to accepting almost all foods. Familiarity with the human and the human's demonstration did not affect responses to the foods. The humans' predictions concerning the chimpanzees' acceptance of the different foods were rather good; furthermore, in seven cases out of eight the humans' preferences did not correlate with their predictions on the chimpanzees' preferences. The finding that most captive chimpanzees are initially cautious toward novel foods supports the little information there is regarding this subject in wild chimpanzees. However, the lack of influence of the humans' familiarity and demonstration on the response to food by the chimpanzees calls for more naturalistic studies, in which social influences are provided by group members. Since novel stimuli provide sensory stimulation and elicit exploration and social interest, occasional presentation of novel foods could be a promising and cheap device for feeding enrichment. Zoo Biol 21:539–548, 2002. © 2002 Wiley-Liss, Inc.

Key words: chimpanzees; food neophobia; social influences; enrichment

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INTRODUCTION

Neophobia has been extensively studied in wild rats, which are very sensitive to changes in otherwise familiar situations. Familiar items (objects or foods) are at first avoided when the rat finds them in a new place, and the rat will similarly avoid novel items. Avoidance of an unfamiliar food declines with time [Barnett, 1963]. Rats, as well as many other animals, learn to avoid a novel food if its ingestion is followed by negative gastro-intestinal consequences [for review, see Bernstein, 1999]. The initial avoidance of novel foods, combined with food aversion learning, prevents the risk of being poisoned, whereas waning of food avoidance through time allows enlargement of the diet and prevents starvation when staple foods are unavailable.

Many primate species are hesitant to eat novel foods, and social and environmental factors influence the degree to which they are neophobic (e.g., capuchin monkeys (*Cebus apella*) [Visalberghi and Fragaszy, 1995]; *Macaca fuscata* [Kawai, 1960; Hikami et al., 1990; Matsuzawa et al., 1983] (but see Fedigan [1991]); *Macaca mulatta* [Johnson, 2000]; *Callithrix jacchus* [Vitale and Queyras, 1997]; and humans [Birch and Marlin, 1982]). Moreover, the degree of neophobia differs across species [Tardif, 1994]; and, in the same species, it is stronger in wild populations (capuchin monkeys (Visalberghi et al., unpublished results) [Agostini 2001], and chimpanzees [Matsuzawa and Yamakoshi, 1996; Matsuzawa, 1999]).

Learning food palatability from others can be beneficial, as it can minimize individual error, and discomfort caused by wrong choices. In order to learn, a primate should pay attention to what conspecifics do, and look for information [King, 1994] from more knowledgeable individuals, especially those that are relevant to the learner (e.g., dominant individuals or (for infants) mothers [Hikami et al., 1990]). Moreover, there is evidence that primates learn to associate humans with food palatability. Japanese macaques ''fed artificially for many years in the 'monkey parks' no longer hesitate to eat new food items given to them by humans'' [Watanabe, 1989, p. 129] and rhesus macaques accept novel foods significantly more when given by a human than when accidentally discovered in the environment [Johnson, 2000]. Children, who are also neophobic, are more likely to accept an unfamiliar food from their mother than from a stranger; moreover, if a mother eats the food before providing her child with the same food, the child is more likely to eat it [Harper and Sanders, 1975].

Wild chimpanzees are omnivorous. At Bossou they feed on 246 items (parts of plants) taken from 200 different plant species (out of the 664 plant species identified at Bossou, Republic of Guinea), whereas the local people of the Monon tribe only feed on 83 items from 76 species [Sugiyama and Koman, 1992]. Such a variety of food sources is maintained through social transmission of food selection and/or through an individual's acquisition of new items in the diet [Laland, 1999]. Systematic studies on how wild and captive chimpanzees respond to novel foods and acquire the habit of eating new food items are lacking. Overall, wild chimpanzees are considered to be conservative and unwilling to taste novel foods, although young individuals seems more likely to do so [Nishida et al., 1983]. However, in the wild it is often impossible to establish to what extent a food is novel; for example, Takasaki [1983] reports that one day, for no apparent reason, chimpanzees started to eat mangoes that grew in a familiar area. However, he does not provide information on whether mangoes were eaten before. Matsuzawa and Yamakoshi [1996] provided

Bossou chimpanzees (in the area where they usually spend their time cracking oil-palm nuts) with coula nuts (*Coula edulis*) (also see Matsuzawa [1999]). Coula nuts are not available in the home range of the Bossou chimpanzees, but they are present in a nearby area, where the Nimba chimpanzee community lives. When the Bossou chimpanzees first encountered the coula nuts, five out of the 14 members above 3 years of age completely ignored the nuts. Eight sniffed them, picked them up, and tried to bite them, but none of them used the tools available in the area to try to crack them open. Only one female (estimated age 31), who was probably born in the Nimba community, picked the nut up and immediately cracked it open. Overall, these observations suggest that chimpanzees are neophobic toward potential novel food and that this response varies among individuals. When panda nuts (*Panda oleosa*) were given to the Bossou chimpanzees, the only one who succeeded in opening it tasted the kernel and never attempted to crack one again [Matsuzawa et al., 2001].

Nishida et al. [2000] have investigated what 95 plant species (114 food items) eaten by wild chimpanzees taste like to a human. They found that while ‘‘most of the chimpanzees’ foods had pleasant tastes and were therefore palatable to a human observer, some were very bitter suggesting a higher tolerance for bitter substances in apes than in humans’’ (p. 437). Zoo or captive chimpanzees are easily fed with human foods; however, up to now studies have ignored whether humans familiar with the chimpanzees would be good at predicting which foods these animals are likely to accept.

The aims of the present experiment were to assess: 1) whether captive chimpanzees are neophobic; 2) whether the source of novel foods affects their neophobic response, i.e., whether they will accept novel foods more readily when they are given by a familiar human than by an unfamiliar human (in this case a European, only briefly encountered before); and 3) whether acceptance of the novel food can be increased by a demonstration in which the familiar human or the unfamiliar human eats the same food face to face with the chimpanzee. In our experiment we also assessed 4) to what extent humans who are very familiar with the chimpanzees are able to predict which novel foods the chimpanzees will prefer to eat, and 5) the extent to which humans attribute to chimpanzees their own feeding preferences.

METHODS

The study included eight chimpanzees (*Pan troglodytes*) housed at the Primate Research Institute of the Kyoto University in Inuyama. According to their age, temperament, and personality they were paired so that the members of each pair were as alike as possible. The subjects were: Pair 1: Popo (female, born in 1982) and Pan (female, born in 1983); Pair 2: Pendesa (female, born in 1977) and Ai (female, born in 1976); Pair 3: Puchi (female born in 1966) and Chloe (female born in 1980); and Pair 4: Gon (male, born in 1966) and Akira (male, born in 1976). All of the subjects lived together in a community of 11 chimpanzees in a semi-natural environment enriched with plants and a stream [Ochiai and Matsuzawa, 1997]. The daily diet consisted of monkey chow, apple, banana, sweet potato, cabbage, carrot, and sometimes orange. Moreover, according to seasonal availability, chimpanzees were fed with other vegetables and fruits, and sometimes were informally presented

TABLE 1. List of the 16 novel foods presented to the chimpanzee subjects and humans

	Group A foods	Group B foods
Pair 1	Dates	Dried apple
Pair 2	Fennel	Beets
Pair 3	Green olives	Black olives
Pair 4	Asiago cheese	Emmenthal cheese
Pair 5	Colomba	Cookies
Pair 6	Mackerel fish	Tuna fish
Pair 7	Pine nuts	Chinese matrimony vine
Pair 8	Lupini	Pumpkin seeds

For half of the chimpanzees, Group A foods were assigned to the familiar human condition (FH) and Group B foods to the unfamiliar human condition (UH), and vice versa for the other half of subjects. Paired foods are similar in texture, content, or appearance.

with novel processed and unprocessed foods. Chimpanzees were not food-deprived for testing.

Each subject was tested individually in a familiar play room (5.0 m wide $\times$ 7.2 m deep $\times$ 3.0 m high). Table 1 lists the 16 novel (i.e., never encountered before) foods presented to each subject. Foods were paired on the basis of their similarities in texture, content, and appearance (see Groups A and B in Table 1). When possible each food was cut in small pieces (about 1.5 cm $\times$ 1.5 cm); if not, the food was given whole (e.g., pine nuts, Chinese matrimony vine). In all cases the size of items belonging to the same pair was kept as similar as possible.

All foods were presented within the same testing session; each food was presented 40–50 sec after the end of the presentation of the previous food. In this way, we kept the chimpanzee's attention high during the whole testing session. The presentation of each food consisted of two trials (Trials 1 and 2), with a 10-sec demonstration between the two. The food was presented on a tray connected through a diagonal transparent tube (chute) to the human area. In Trials 1 and 2 the human inserted the food on the chute and let it drop into the tray, as soon as he/she got the chimpanzee's attention. The trial started when the food reached the tray. In the demonstration trial, the human first attracted the chimpanzee's attention, and only then ate the food in a compelling way, in front of the chimpanzee at a distance of no more than 1 m. Each trial lasted 30 sec, or until the food was eaten or was definitively discarded, whichever occurred first. Evidence of discard included giving back the food to the human or throwing it on the floor.

Eight novel foods were given by a familiar human (FH), and eight by an unfamiliar human (UH). Within each food pair, food A was given to one of the paired chimpanzees by the FH, whereas food B was given by the UH and the other subject of the pair had the opposite treatment. During each chimpanzee testing, the FH and UH took turns every four foods. Food presentation and order of the FH and UH turns were counterbalanced across subjects.

To familiarize the chimpanzees with food presentation and with the presence of the UH, every subject received familiar foods (apple, raisins, carrot, and cucumber) in a session preceding the experimental one (pre-test). During the experiment three people (two FH, and one UH) were present in the room; two operated the video cameras and the third tested the subject. The subjects were visible through a

TABLE 2. Behavior scored listed according to increasing levels of acceptance

Score 0. *Not taking*. The food is not taken.
Score 1. *Discarding the food*. The food is taken and then not eaten and discarded. *Smelling*. Food is taken close to the nose and smelled.
Score 2. *Tasting*. The food is contacted with the lips or teeth. Food ingestion is not required.
Score 3. *Nibbling*. Slow eating of no more than half of the piece of food.
Score 4. *Eating*. Food is entirely consumed and the collection of the leftovers in the cage allows to double check whether eating has occurred.

transparent lexan wall. Most of the time the human presenting the foods was about 1 m away from the chimpanzee. The experiment was videotaped with three video cameras positioned on the left, front, and right of the food tray. Special attention was given to the eyes of the chimp and to whether it was attentive during the demonstration. The behaviors scored are shown in Table 2, ranked according to an increasing level of interest or consumption of food. E.V. scored the behavior of the subjects from the three tapes available for the testing. At the end of each subject's session, the leftovers in the cage were collected and the behavioral data were double checked.

Before starting the experiment, nine humans, all of whom were very familiar with the chimpanzees and their feeding habits, were requested to taste the foods (most of which were novel for them too) and to rank them 1) according to which ones they would predict the chimpanzees to prefer; and 2) according to their personal preference. Their predictions about the chimpanzees' acceptance were used to balance, as much as possible, the food pairs belonging to groups A and B (see Table 1). The experiment was carried out in April 1998.

Statistical Analysis

As shown in Table 2, the behaviors ranged between levels 0 and 4, with higher values indicating higher food acceptance. Analysis were carried out on the highest acceptance score recorded in each trial. A Friedman analysis of variance (ANOVA) was carried out on the scores obtained in the FH and UH conditions before and after demonstration. The Wilcoxon signed-ranks test was used to compare the differences in the chimpanzees' scores in trials 1 and 2 (Δ) between the FH and UH conditions.

The Kruskal-Wallis ANOVA was used to assess whether in each condition the scores differed among chimpanzees. The Spearman correlation was used to assess whether the rank of the humans' predictions (average value) on which foods the chimpanzees would be more likely to eat and the number of chimpanzees that indeed ate each food correlated, and whether the prediction made by each human correlated with his/her own preferences. The Kendall coefficient of concordance was used to assess whether there was an agreement on the foods the chimpanzees preferred to eat, and on the predictions made by the humans about these preferences.

RESULTS

In the pre-test, the chimpanzees ate the familiar foods as soon as they received them (usually in 2–3 sec, and never later than 5 sec). No tasting, nibbling, or smelling occurred. To describe the chimpanzee's response to novel foods we first indicate whether they ate them, and then examine their level of acceptance by providing the results of the analysis performed by considering their acceptance scores, as ranked in Table 2.

Eating

The chimpanzees' responses to the 16 novel foods varied from almost total acceptance to general refusal (Fig. 1). The average number of different foods eaten by the chimpanzees (out of the 16 presented) was 7.8. There were marked differences among the chimpanzees in the acceptance of novel foods. One subject (Ai) did not consume any food, whereas Popo ate 13 and 14 foods out of 16 (in Trials 1 and 2, respectively).

Eating occurred in 43% of Trial 1 and in 45% of Trial 2, and the average number of different foods eaten was 6.9 in Trial 1 (range 0–13) and 7.1 in Trial 2 (range 0–14). Overall, in seven cases a food was not eaten in Trial 1 but was eaten in Trial 2; in four cases the opposite occurred. These switches were scored six times in the FH and five times in the UH conditions. For group A foods, eating increased in four cases and decreased in one case; for group B foods, eating increased in three cases and decreased in three cases.

Influence of the Demonstration on the Acceptance of the Novel Foods

In both the FH and UH conditions and in both Trial 1 and Trial 2, there were marked interindividual differences in chimpanzees' acceptance scores (see Table 2)

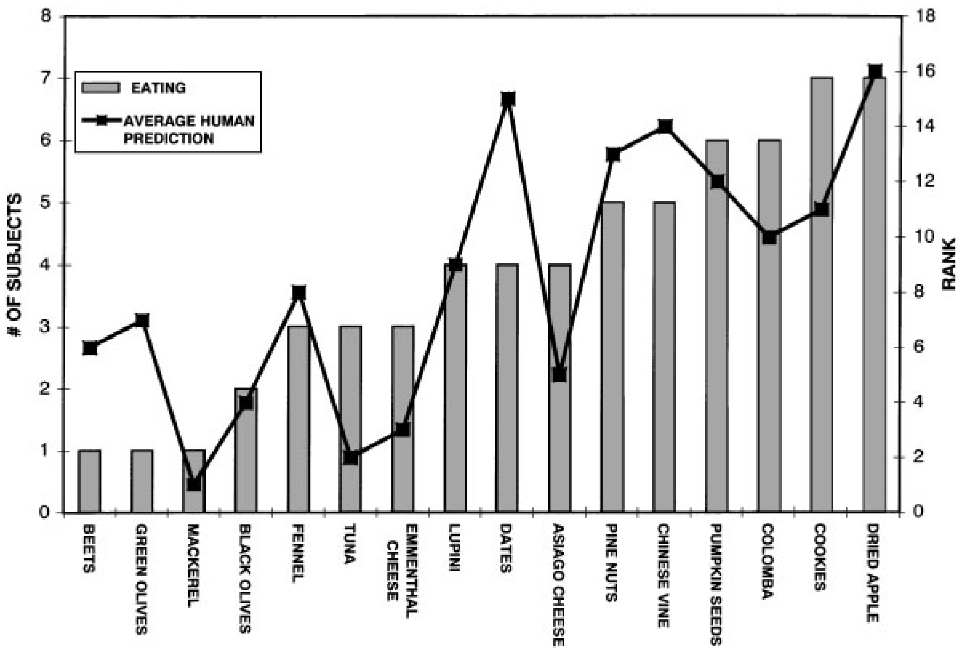

Fig. 1. Number of chimpanzee subjects that ate (level 4, as defined in Table 2) in Trial 1 or Trial 2 the 16 novel foods (bars), and average prediction of the humans about the foods more likely to be eaten by the chimpanzees (line).

(Kruskal-Wallis ANOVA, FH condition: Trial 1, $H = 27.7$, Trial 2, $H = 30.5$; UH condition: Trial 1, $H = 28.7$, Trial 2, $H = 30.1$; in all cases $P < 0.0002$, $n = 8$).

Chimpanzees paid attention to the demonstration in all trials. In the FH condition chimpanzees' acceptance scores were 20.4 ± 3.0 in Trial 1 and 18.5 ± 3.6 in Trial 2 after demonstration; the scores in the UH condition were 20.6 ± 2.7 in Trial 1 and 17.4 ± 3.8 in Trial 2. A two-way Friedman ANOVA showed that demonstration (Trial 1 vs. Trial 2) and experimenter's familiarity (FH vs. UH) did not affect chimpanzees' acceptance scores ($\chi^2_3 = 2.5$, $n = 8$, NS). The power of this test was >0.8, showing that the probability of being wrong in accepting the null hypothesis was very small. Moreover, the Δ between Trial 1 and Trial 2 did not differ between conditions ($T = 6$, $n = 8$).

Humans' Predictions

The humans showed different preferences toward the 16 foods (Kendall coefficient of concordance, $W = 0.28$, $n = 9$). Moreover, their predictions about which foods on average the chimpanzees would prefer were not in agreement (Kendall coefficient of concordance, $W = 0.60$, $n = 9$). Nevertheless, the humans' predictions (average value) about which foods the chimpanzees would be more likely to eat and the number of chimpanzees that indeed ate each food was significantly correlated ($r_s = 0.75$, $P < 0.001$, $n = 16$; the S value for each prediction ranged between 0.87 and 0.35). Finally, the correlation between each human's food preferences and those he/she predicted for the chimpanzees were correlated in only one case out of eight ($r_s = 0.74$, $P < 0.01$, $n = 16$; the other nonsignificant values ranged between 0.74 and –0.22).

DISCUSSION

The chimpanzees' responses to the novel foods ranged from extreme reluctance to eagerness to eat the novel foods. Despite these marked interindividual differences, no novel food was eaten by all of them. These findings support the little information available concerning wild chimpanzees when they encounter novel foods that are palatable to humans or are eaten by other chimpanzee groups [Takasaki, 1983; Nishida et al., 1983; Matsuzawa, 1999; Matsuzawa et al., 2001]. However, it would be of great interest to assess how young chimpanzees would respond in a similar experimental condition, since young primates are less reluctant to eat novel foods than are adults [Nishida et al., 1983; Fragaszy et al., 1997].

The eating and acceptance of novel foods by the chimpanzees was not influenced by the familiarity of the human providing the novel food. In fact, although chimpanzees were always attentive to the human (either familiar or unfamiliar) eating the novel food, food acceptance did not increase after demonstration. Although the chimpanzee/human dyad does not represent the usual situation in which exchange of information about food occurs, for captive chimpanzees (such as those used in the present study) such interactions are of great importance, since they pace and fill their everyday life.

As Greenberg [1990, p. 433] noted, ''novelty responses do not provide a rigid barrier but a brake that slows foraging niche expansion,'' and novelty responses are affected by several experiences, such as repeated exposures and social influences, especially early in life. It is possible that, as observed in captive capuchin monkeys, chimpanzees' acceptance of novel foods would have increased after repeated exposures to the same food [Visalberghi et al., 1998], or in the presence of group members eating [Visalberghi and Addessi, 2000]. It is also possible that the information about food palatability as provided by humans in our study was not salient enough to influence the neophobic behavior of a chimpanzee (but see above). Finally, a better understanding of the balance between neophobia and neophilia necessitates a systematic study in the wild, similar to that recently carried out on semi-free ranging rhesus macaques by Johnson [2000]. In that study the macaques were presented with novel and familiar foods during periods of normal provisioning and periods when provisioning was suspended.

In our study, both humans and chimpanzees differed in their preference/acceptance of the novel foods. However, as expected on the basis of the similarity between chimpanzee and human taste [Nishida et al., 2000], all the foods (which were common human foods) were accepted by one or more chimpanzees. Moreover, overall the humans' predictions were rather good and not based on their own preferences, i.e., their predictions were not inspired by an anthropomorphic attitude. This finding is encouraging, as it shows that daily care of the chimpanzees, which includes feeding them with their varied staple diet, provides people with knowledge of the chimpanzees' responses to novel foods.

According to the European Federation of Primatology [1999], a nutritionally adequate diet is not sufficient to promote the psychological well-being of captive primates, and initiatives fostering periodical change in food sources and preventing a standardized and monotonous diet should be undertaken. For humans there is anecdotal evidence that monotonous diets are disliked, and dietary monotony could be seen as a form of sensory deprivation [Pelchat and Schaefer, 2000]; besides, variety of diet is advised when non-human primates are kept in captivity [NRC, 1998; APHIS, 1999]. Although there is plenty of evidence that foraging substrates and foods that require processing foster captive primates' well-being [NRC, 1998; APHIS, 1999] (for chimpanzees, see Bloomsmith [1989]), no study has yet investigated whether the presentation of novel foods and dietary variety are beneficial for the well-being of captive primates. Since novel stimuli provide sensory stimulation, and elicit exploration and social interest (common activities in the everyday life of wild primates), we believe that the occasional presentation of novel foods is a promising and inexpensive device for feeding enrichment.

CONCLUSIONS

1. There were marked interindividual differences in the chimpanzees' response toward 16 novel foods commonly eaten by human beings. The response varied from acceptance of almost all the foods to almost complete refusal.

2. The chimpanzees' acceptance of a novel food was not affected by whether that food was provided by a familiar or an unfamiliar human, or by seeing a brief demonstration in which a human ate the food.

3. Predictions about the chimpanzees' preferences made by humans familiar with the chimpanzees were not inspired by an anthropomorphic attitude.

4. Future research should investigate whether occasional presentation of novel foods can be used as feeding enrichment.

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REFERENCES

Agostini A. 2001. Neofobia in *Cebus apella nigritus*: uno studio sperimentale nel Parco Nazionale di Iguazù, Argentina. Master's thesis, University La Sapienza, Rome.

APHIS (Animal and Plant Health Inspection Service). 1999. Final report on environment enhancement to promote the psychological well-being of non-human primates. U.S. Dept. of Agriculture, Animal and Plant Health Inspection Service, Animal Care, Riverdale, MD. 108 p.

Barnett SA. 1963. The rat. A study in behaviour. Chicago: Aldine Publishing Company. 288 p.

Bernstein IL. 1999. Taste aversion learning: a contemporary perspective. Nutrition 15:229–34.

Birch LL, Marlin DW. 1982. I don't like it; I never tried it: effects of exposure on two-year-old children's food preferences. Appetite 3:353–60.

Bloomsmith MA. 1989. Feeding enrichment for captive great apes. In: Segal EF, editor. Housing, care and psychological wellbeing of captive laboratory primates. Park Ridge, NJ: Noyes Publication. p 336–56.

European Federation of Primatology. 1999. Diet, foraging behavior and time budget in non-human primates: how field studies may help improve the welfare of captive primates. Workshop of the European Federation of Primatology. Folia Primatol 70:62–4.

Fedigan LM. 1991. History of the Arashiyama West Japanese macaques in Texas. In: Fedigan LM, Asquith PJ, editors. The monkeys of Arashiyama. Albany, NY: State University of New York Press. p 54–73.

Fragaszy DM, Feuerstein JM, Mitra D. 1997. Transfers of food from adults to infants in tufted capuchins (*Cebus apella*). J Comp Psychol 111:194–200.

Greenberg R. 1990. Ecological plasticity, neophobia and resource use in birds. Stud Avian Biol 13:431–7.

Harper LV, Sanders KM. 1975. The effect of adults' eating on young children acceptance of unfamiliar foods. J Exp Child Psychol 20:206–14.

Hikami K, Hasegawa Y, Matsuzawa T. 1990. Social transmission of food preferences in Japanese monkeys (*Macaca fuscata*) after mere exposure or aversion training. J Comp Psychol 104:233–7.

Johnson E. 2000. Food-neophobia in semi-free ranging rhesus macaques: effects of food limitation and food source. Am J Primatol 50:25–35.

Kawai M. 1960. A field experiment on the process of group formation in the Japanese monkey (*Macaca fuscata*) and the releasing of the group at Ohirayama. Primates 2:181–225.

Laland KN. 1999. Exploring the dynamics of social transmission in rats. In: Box HO, Gibson KR, editors. Mammalian social learning: comparative and ecological perspectives. Cambridge: Cambridge University Press. p 174–87.

Matsuzawa T. 1999. Communication and tool use in chimpanzees: cultural and social contexts. In: Hauser MD, Konishi M, editors. The design of animal communication. Cambridge, MA: MIT Press. p 645–71.

Matsuzawa T, Yamakoshi G. 1996. Comparison of chimpanzee material culture between Bossou and Nimba, West Africa. In: Russon A, Bard K, Parker S, editors. Reaching into thought. The minds of the great apes. Cambridge: Cambridge University Press. p 211–32.

Matsuzawa T, Hasegawa Y, Gotoh S, Wada K. 1983. One-trial long-lasting food-aversion learning in wild Japanese monkeys (*Macaca fuscata*). Behav Neural Biol 39:155–9.

Matsuzawa T, Biro D, Humle T, Inoue-Nakamura N, Tonooka R, Yamakoshi G. 2001. Emergence of culture in wild chimpanzees: education by master-apprenticeship. In: Matsuzawa T, editor. Primate origin of human cognition and behavior. Tokyo: Springer-Verlag. p 557–74.

NRC (National Research Council). 1998. The psychological well-being of nonhuman primates. Report of the Committee on the Well-Being of Nonhuman Primates. Institute for Laboratory Animal Research, National Research Council. Washington, DC: National Academy Press.

Nishida T, Wrangham RW, Goodall J, Uehara S. 1983. Local differences in plant feeding habits of chimpanzees between the Mahale mountains and Gombe National Park, Tanzania. J Hum Evol 12:467–80.

Nishida T, Ohigashi H, Koshimizu K. 2000. Tastes of chimpanzee plant foods. Curr Anthropol 41: 431–8.

Ochiai T, Matsuzawa T. 1997. Planting trees in an outdoor compound of chimpanzees for an enriched environment. In: Hare VJ, Worley KE, editors. Proceedings of the Third

International Conference on Environmental Enrichment. p 355–64.
Pelchat ML, Schafer S. 2000. Dietary monotony and food cravings in young and elderly adults. Physiol & Behav 68:353–9.
Sugiyama Y, Koman J. 1992. The flora of Bossou: its utilization by chimpanzees and humans. Afr Study Monogr 13:127–69.
Takasaki H. 1983. Mahale chimpanzees taste mangoes — toward acquisition of a new food item? Primates 24:273–5.
Tardif SD. 1994. Sensitive *Saguinus* and courageous *Callithrix*: differences in adaptability and neophobia in two callithrid genera. AZA Regional Conference Proceedings. p 408–12.
Visalberghi E, Fragaszy D. 1995. The behaviour of capuchin monkeys, *Cebus apella*, with novel foods: the role of social context. Anim Behav 49:1089–95.
Visalberghi E, Valente M, Fragaszy D. 1998. Social context and consumption of unfamiliar foods by capuchin monkeys (*Cebus apella*) over repeated encounters. Am J Primatol 45:367–80.
Visalberghi E, Addessi E. 2000. Seeing group members eating a familiar food enhances the acceptance of novel foods in capuchin monkeys. Anim Behav 60:69–76.
Vitale A, Queyras A. 1997. The response to novel foods in common marmoset (*Callithrix jacchus*): the effects of different social contexts. Ethol 103:395–403.
Watanabe K. 1989. Fish: a new addition to the diet of Japanese macaques on Koshima Island. Folia Primatol 52:124–31.