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Chimpanzees use self-distraction to cope with impulsivity

Theodore A. Evans* and Michael J. Beran

Language Research Center, Georgia State University, University Plaza, Atlanta, GA 30302, USA
*Author for correspondence (theodore.evans@gmail.com).

It is unknown whether animals, like humans, can employ behavioural strategies to cope with impulsivity. To examine this question, we tested whether chimpanzees (*Pan troglodytes*) would use self-distraction as a coping strategy in a situation in which they had to continually inhibit responses to accumulating candies in order to earn a greater amount of those rewards. We tested animals in three conditions in which they were sometimes given a set of toys and were sometimes allowed physical access to the accumulating candies. Chimpanzees allowed the rewards to accumulate longer before responding when they could divert their attention to the toys, and they manipulated the toys more when the candies were physically accessible. Thus, chimpanzees engaged in self-distraction with the toys when such behaviour was most beneficial as a coping mechanism.

Keywords: self-distraction; self-control; impulsivity; chimpanzee; *Pan troglodytes*

1. INTRODUCTION

Considerable research has been conducted to understand human impulsivity and self-control (Logue 1988; Rachlin 2000), some of which has been devoted to understanding the strategies people may use to control or cope with impulsivity. For example, researchers have shown that young children will adopt simple coping mechanisms, such as engaging in distracting play or thought, when faced with frustrating delay of gratification tasks (Mischel *et al.* 1972; Miller & Karniol 1976; Toner & Smith 1977). Although we, as a species, may take this ability for granted, it requires a level of behavioural sophistication rarely seen in other organisms. Animal species show some ability to solve simple less-now versus more-later inhibition problems involving delays of 30 s or less (Tobin & Logue 1994; Stevens *et al.* 2005). However, there is little research to suggest that animals, like humans, can influence their own susceptibility to impulsivity (but see Ainslie 1974). To address this issue, we tested whether chimpanzees (*Pan troglodytes*) would distract themselves to prevent impulsive responses to enticing rewards.

Although chimpanzees show greater capacity to delay gratification than many other animals (Beran *et al.* 1999; Beran 2002; Beran & Evans 2006), there is no experimental evidence indicating that chimpanzees can employ strategies to cope with impulsivity. However, there is some evidence indicating that chimpanzees use behavioural strategies to cope with various emotional states in other situations, such as when faced with crowded or confined conditions (Aureli & de Waal 1997), or challenged cognitively (Leavens *et al.* 2001). Given these findings, it is reasonable to expect that chimpanzees also would exhibit coping behaviour in response to the frustration associated with delaying gratification.

To test this possibility, we adopted a simple paradigm that has been used with children (Mischel *et al.* 1972; Miller & Karniol 1976; Toner & Smith 1977). In those studies, children were asked to wait for a specified period of time either to receive a highly preferred reward or to accumulate a certain quantity of rewards during the session. However, they were also given the option of ending the session early to receive a less preferred reward or fewer rewards. Some children distracted themselves (either spontaneously or by instruction) by talking or singing aloud, or by avoiding visual contact with the reward items and directing their attention to irrelevant objects in the room. These behaviours allowed the children to wait longer before stopping the session. This showed that the children were able to adopt simple, but effective, methods that would influence their own susceptibility to impulsivity in these tasks.

We tested four chimpanzees in a scenario equivalent to that used with children to determine whether chimpanzees could distract themselves from task rewards so as to obtain a better outcome. We tested each chimpanzee individually in a task in which candies accumulated in a container in front of them. In two experimental conditions, the candies accumulated in a container within reach of the chimpanzee and the candies could be eaten at any time. However, as soon as the chimpanzee disconnected the container to consume the candies, no more were delivered. Thus, in the two experimental conditions, the chimpanzee had complete control over how long it had to wait before eating candies, and the longer the chimpanzee delayed gratification the more candies it would receive. In one of these two conditions, the chimpanzee was provided with a small set of inedible objects (toys), whereas no objects or other distractions were provided in the other condition. We expected each chimpanzee to delay gratification longer when the toys were available. This would indicate one of two things: either the presence of the toys made the chimpanzees temporarily forget about the nearby accumulating candies or the chimpanzees actively engaged in play behaviour to divert their attention from the enticing rewards. To differentiate between these two alternative hypotheses, we presented the animals with a third (control) condition in which the container holding the accumulating set of candies was positioned out of the chimpanzee's reach (but was still visible), leaving the chimpanzee no control over the delay length. In this condition, the chimpanzee was also provided with a set of toys. If the chimpanzees were using the toys to actively distract themselves as a means of coping with impulsivity, we would expect them to manipulate the toys less in this control condition than in the experimental

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Table 1. Statistical results. (Two-tailed tests, $\alpha = 0.05$.)

		subject			
analysis	statistic	Lana	Mercury	Panzee	Sherman
rewards obtained as a function of toy availability	*Z*	2.346	2.226	2.451	1.277
	N	10	10	10	10
	p	0.019	0.026	0.014	0.201
toy manipulation as a function of reward accessibility	*Z*	0.464	2.191	2.701	2.803
	N	10	10	10	10
	p	0.444	0.028	0.007	0.005
rewards obtained in relation to toy manipulation	*r*	(0.345)			
	d.f.	(38)			
	p	(0.029)			

condition in which the food was available at any time. If, however, the toys operated solely to make the chimpanzees temporarily forget about the nearby accumulating candies, the levels of toy manipulation would be equivalent in both the experimental and control conditions.

2. MATERIAL AND METHODS

(a) *Subjects*

We observed four chimpanzees: Lana (36-year-old female), Sherman (33-year-old male), Panzee (21-year-old female) and Mercury (20-year-old male). The chimpanzees were familiar with the delay of gratification paradigm used in the present study (Beran & Evans 2006).

(b) *Materials*

The test apparatus consisted of a mobile cart holding a personal computer connected to a 36-item universal feeder. The dispenser was located approximately 1.5 m above the floor and the candies it held were visible to the chimpanzee at all times. Dispensed candies fell into a funnel that fed a clear plastic tube that ran down to the floor. At the floor, a clear container was attached to the tube in such a way that a pull or tug on the container would disconnect it from the tube (and the dispenser unit).

A computer program controlled the delivery of candies via the universal dispenser. Once initiated, the program would signal the feeder to deliver candies to the collection container, one after another, with a 30 s interval between items. The program also produced a tone each time a candy was dispensed and counted the number of candies dispensed across the session. For experimental sessions, the computer program was set to deliver the maximum number of candies (36). However, the actual number of candies delivered was determined by the chimpanzees' behaviour during sessions (see below). For control sessions, the program was set to deliver the exact number of food items that had been obtained in the previous session in which toys were available. The experimenter observed test sessions via a closed-circuit television monitor, located outside the test area, connected to a digital video camera that was directed towards the chimpanzee. The experimenter was not visible to the chimpanzee from this vantage point.

(c) *Design and procedure*

Each chimpanzee was tested individually and completed a single session per day. At the beginning of a session, the experimenter stocked the dispenser with 36 candies and then positioned the collection container either in the chimpanzee's enclosure, so that the chimpanzee could disconnect it at any time (experimental sessions), or outside the enclosure where the chimpanzee could see it but not touch it (control sessions). In half of the experimental sessions, and in all control sessions, the experimenter also placed a randomly selected set of three objects (toys) into the enclosure with the chimpanzee. The toys were handed to the chimpanzee just prior to the beginning of the session. The experimenter then walked out of the testing area to the front of the building where the closed-circuit monitor was located and immediately started the computer program. From this vantage point, the experimenter recorded the amount of time the subject spent actively manipulating any of the available toys prior to disconnecting the collection container from the dispensing unit to consume the candies. When the chimpanzee disconnected the container, the experimenter pressed a keyboard button to end the computer program and the session. At the end of control sessions, the experimenter walked back into the test area, disconnected the collection container from the apparatus and handed it to the chimpanzee.

Test sessions were presented in 3-day blocks, in which one session of each type was conducted on a different day (experimental with toys, experimental without toys and control). Each chimpanzee participated in 10 blocks for a total of 30 test days (10 trials per condition). The presentation order of the sessions was randomized within each block with the constraint that the control condition had to occur sometime after the experimental condition in which toys were available. This constraint allowed the experimenter to ensure that the number of candies dispensed (and the duration of time spent waiting) in the control condition exactly matched the number of dispensed candies and duration of wait time in the previous experimental condition involving toys.

(d) *Statistical analyses*

The first author (T.A.E.) coded all test sessions in real time, and a blind observer coded one block of test sessions (from video) for each chimpanzee for the purpose of assessing inter-observer reliability. Using a two-tailed Pearson correlation, strong agreement was found between the total duration of object interaction time coded by the two observers ($r = 0.996$, $n = 8$, $p < 0.01$).

Given our small sample size, individual-by-individual analyses were conducted whenever possible. Wilcoxon signed-rank tests were conducted to compare the number of candies obtained by each chimpanzee in experimental sessions as a function of the availability of toys objects, as well as to compare toy-manipulation time for each chimpanzee as a function of the accessibility of the food rewards (experimental versus control conditions). A Pearson correlation was conducted to assess the relationship between the proportion of total session time that the chimpanzees spent manipulating toy objects and the number of items the chimpanzees obtained (experimental sessions with toys).

3. RESULTS

Across all three conditions, chimpanzees obtained between 1 and 36 candies (mean = 15), delaying gratification between 0.5 and 18 min (mean = 7.5 min). Most chimpanzees obtained significantly more candies when toys were available than when toys were not available (table 1; figure 1*a*). Additionally, most chimpanzees spent significantly more time manipulating toys when the candies were physically accessible compared with when the candies were out of reach (table 1; figure 1*b*). The proportion of total session time in which the chimpanzees manipulated the toys was positively correlated with the number of candies they obtained (table 1; figure 2).

4. DISCUSSION

In this study, most chimpanzees waited longer to respond to a set of accumulating candies when they

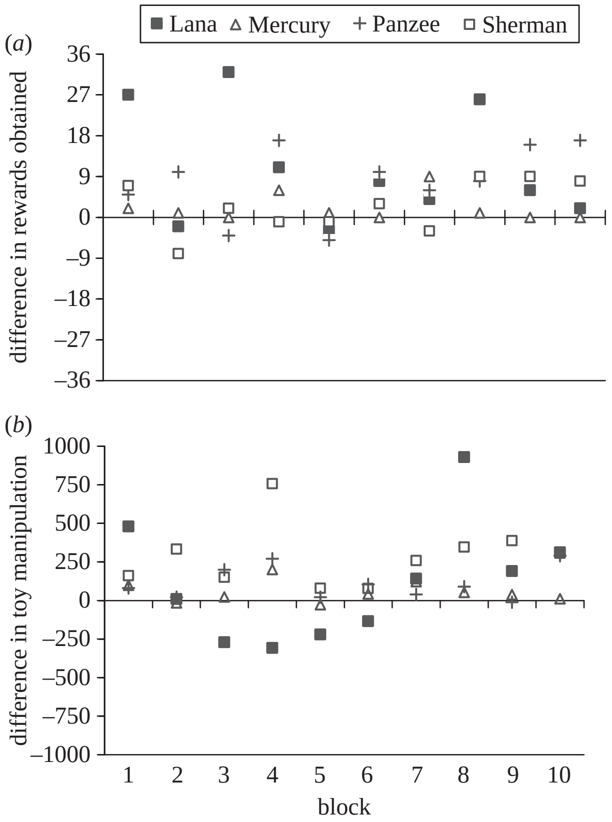

Figure 1. Difference in performance on the basis of the experimental condition. Data points represent (*a*) the arithmetic difference between rewards obtained in the toys-available condition and the toys-unavailable condition, or (*b*) the arithmetic difference between toy manipulation in the rewards-accessible condition and the rewards-inaccessible condition. Thus, points above the midline indicate (*a*) more food rewards obtained in the experimental condition with toys compared with the condition without toys or (*b*) larger amounts of time spent manipulating toys in the experimental condition compared with the control condition.

had access to toys. The one animal that did not show this effect (Sherman) exhibited very high performance even without the availability of toys (mean = 27.4 items), and he was therefore least likely to benefit from a coping strategy. Most chimpanzees also played with the toys more when they had physical access to the candy container, and thus, had to inhibit responses to those items. Therefore, they were not passively distracted by the presence of the toys but were actively engaged in toy manipulation to divert their attention from the accumulating candies. The one animal that did not show this effect (Lana) showed the same level of interest in the toys in each condition and, therefore, did not self-distract. Finally, we found that the animals accumulated more candies when they spent greater proportions of time manipulating the toys (though this effect was driven mostly by the performance of two individuals, Panzee and Sherman). Thus, there was a direct relationship between the chimpanzees' ability to delay gratification and the amount of self-distraction that they exhibited. This behaviour presumably aided the chimpanzees in delaying gratification because it diverted their attention away from the highly tempting food items, just as such behaviour did for children in similar previous

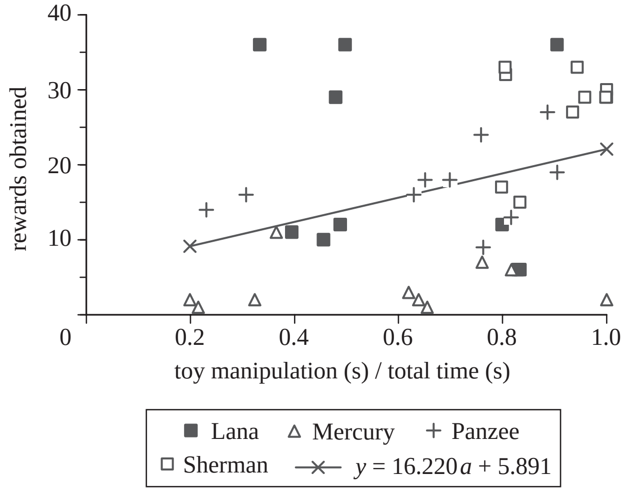

Figure 2. Rewards obtained in relation to the proportion of time spent manipulating toys. Data are presented from the condition in which toys were available and rewards were accessible. The solid line represents the best-fit regression line ($r = 0.345$, d.f. $= 38$, $p < 0.029$).

studies (Mischel *et al.* 1972; Miller & Karniol 1976; Toner & Smith 1977). This is the first evidence indicating that non-human animals can use a behavioural strategy to reduce their own susceptibility to ongoing temptation.

This research adhered to the Association for the Study of Animal Behaviour/Animal Behaviour Society Guidelines for the Use of Animals in Research (published on the *Animal Behaviour* website), the legal requirements of the country in which the work was carried out and all institutional guidelines.

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Ainslie, G. W. 1974 Impulse control in pigeons. *J. Exp. Anal. Behav.* **21**, 485–489. (doi:10.1901/jeab.1974.21-485)

Aureli, F. & de Waal, F. B. M. 1997 Inhibition of social behavior in chimpanzees under high-density conditions. *Am. J. Primatol.* **41**, 213–228. (doi:10.1002/(SICI)1098-2345(1997)41:3<213::AID-AJP4>3.0.CO;2-)

Beran, M. J. 2002 Maintenance of self-imposed delay of gratification by four chimpanzees (*Pan troglodytes*) and an orangutan (*Pongo pygmaeus*). *J. Gen. Psychol.* **129**, 49–66.

Beran, M. J. & Evans, T. A. 2006 Maintenance of delay of gratification by four chimpanzees (*Pan troglodytes*): the role of delayed reward visibility, experimenter presence, and extended delay intervals. *Behav. Processes* **73**, 315–324. (doi:10.1016/j.beproc.2006.07.005)

Beran, M. J., Savage-Rumbaugh, E. S., Pate, J. L. & Rumbaugh, D. M. 1999 Delay of gratification in chimpanzees (*Pan troglodytes*). *Dev. Psychobiol.* **34**, 119–127. (doi:10.1002/(SICI)1098-2302(199903)34:2<119::AID-DEV5>3.0.CO;2-P)

Leavens, D. A., Aurelli, F., Hopkins, W. D. & Hyatt, C. W. 2001 Effects of cognitive challenge on self-directed behaviors by chimpanzees (*Pan troglodytes*). *Am. J. Primatol.* **55**, 1–14. (doi:10.1002/ajp.1034)

Logue, A. W. 1988 Research on self-control: an integrating framework. *Behav. Brain Sci.* **11**, 665–709.

Miller, D. T. & Karniol, R. 1976 The role of rewards in externally and self-imposed delay of gratification. *J. Pers. Soc. Psychol.* **34**, 310–316. (doi:10.1037/0022-3514.34.2.310)

Mischel, W., Ebbesen, E. B. & Zeiss, A. R. 1972 Cognitive and attentional mechanisms in delay of gratification. *J. Pers. Soc. Psychol.* **21**, 204–218. (doi:10.1037/h0032198)

Rachlin, H. 2000 *The science of self-control*. Cambridge, MA: Harvard University.

Stevens, J. R., Rosati, A. G., Ross, K. R. & Hauser, M. D. 2005 Will travel for food: spatial discounting in two New World monkeys. *Curr. Biol.* **15**, 1855–1860. (doi:10.1016/j.cub.2005.09.016)

Tobin, H. & Logue, A. W. 1994 Self-control across species (*Columbia livia*, *Homo sapiens*, and *Rattus norvegicus*). *J. Comp. Psychol.* **108**, 126–133. (doi:10.1037/0735-7036.108.2.126)

Toner, I. J. & Smith, R. A. 1977 Age and overt verbalization in delay-maintenance behavior in children. *J. Exp. Child Psychol.* **24**, 123–128. (doi:10.1016/0022-0965(77)90025-X)