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Perceived Control in Rhesus Monkeys (*Macaca mulatta*): Enhanced Video-Task Performance

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This investigation was designed to determine whether perceived control effects found in humans extend to rhesus monkeys (*Macaca mulatta*) tested in a video-task format, using a computer-generated menu program, SELECT. Choosing one of the options in SELECT resulted in presentation of 5 trials of a corresponding task and subsequent return to the menu. In Experiments 1–3, the animals exhibited stable, meaningful response patterns in this task (i.e., they made choices). In Experiment 4, performance on tasks that were selected by the animals significantly exceeded performance on identical tasks when assigned by the experimenter under comparable conditions (e.g., time of day, order, variety). The reliable and significant advantage for performance on selected tasks, typically found in humans, suggests that rhesus monkeys were able to perceive the availability of choices.

It has frequently been suggested, with some empirical support, that the perception of freedom and personal control has broad positive effects on human affect, attitude, and behavior (e.g., Burger, 1975; Winocur, Moscovitch, & Freedman, 1987). Moreover, there are data to suggest that choice and control may result in enhanced levels of performance. That is, the perception of choice and control may actually improve the quality or quantity of responses by human subjects (Burger, 1987; Chan, Karbowski, Monty, & Perlmuter, 1986; Monty & Perlmuter, 1986; Perlmuter & Monty, 1977; Savage, Perlmuter, & Monty, 1979). In each of these investigations, subjects were given some degree of control over task demands and exhibited enhanced performance levels relative to non-choice control groups. On the basis of these and other data, researchers have argued that it is the *perception* of control, rather than control[1] per se that is necessary and critical for such effects to be exhibited (e.g., Perlmuter & Monty, 1977, p. 763). Subjects who believe that they have control over environmental circumstances–whether or not this perception is veridical–exhibit enhanced performance (see also Alloy & Abramson, 1979; Burger, 1989; Langer, 1975).

Two explanations have been offered for the benefits of perceived control on performance. Perlmuter and Monty (1977) have suggested that perceived control affects the motivational level of an organism such that increased choice produces increased motivation and, consequently, enhanced performance. In contrast, Burger (1975, 1987, 1989) cites self-presentation concerns as a mediator of the effects of perceived control on performance. According to this view, increases in perceived control frequently result in largely negative consequences such as increased responsibility and concern for how one will be viewed by others. Task choice, according to Burger, is tantamount to a statement of expertise. Given the burden of responsibility for task choice, one will strive to preserve the appearance of competence.

It is difficult to apply Burger's (1989) interpretation of these effects of perceived control on performance by nonhuman organisms, for whom behavioral effects of choice have also been reported (see Rumbaugh & Sterritt, 1986, for a review of these findings). Several studies report that animals given choice over some aspect of the environment tend to cope better, in various ways, with noxious circumstances (e.g., Hanson, Larson, & Snowdon, 1976; Seligman, 1975; Weiss, 1971). For example, Hanson et al. exposed two groups of rhesus monkeys to a loud noise. One group could terminate the noise with a response, whereas the other group of monkeys had no means of regulating the noise. Following the noise periods, the group of rhesus with choice manifested lower cortisol levels and fewer aggressive behaviors than did their counterparts.

Thus, the opportunity to make choices that affect one's environment is generally positive and enriching even for nonhuman organisms, and individuals of many species may address stressors with greater facility given some degree of control over those stressors (e.g., Snowdon & Savage, 1989). On the other hand, there is little, if any, clear evidence to suggest that choice can enhance performance in nonhuman primates, that is, can improve either the quality or the quantity of responses. Such findings would seem to be quite important, as it would be highly speculative and anthropo-

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[1] Hereafter, *choice* and *perceived control* are used interchangeably for this meaning of the word *control.* The latter will be reserved to refer to humans, as they can report their perceptions, except in those cases in which the data allow the *perception* of control by nonhuman organisms to be inferred. The word *control,* used alone, will generally be reserved to mean *experimental* control.

morphic to suppose that, when given choices, monkeys or other nonhuman primates performed better out of concern for self-presentation, as suggested by Burger (1989).

In the present investigation, rhesus monkeys were allowed to choose the tasks on which they would work to determine the effects that such choice would have on performance. A number of the factors that typically covary with choice (e.g., preference patterns, timing factors), thereby obfuscating the interpretation of the data, were controlled in this experiment. Yoked control sessions, in which the exact tasks that had been chosen by each of the subjects were assigned to the animals, were used to provide performance baselines under comparable conditions. Consequently, the effects of choice on performance were assayed without confounding from factors such as differential learning, variety, and task order.

The justification for these experiments is twofold. As has been suggested, enhancements of performance by nonhuman subjects as a function of choice would serve to depreciate the strength of Burger's (1989) hypothesis. However, any effects of choice on performance levels in nonhuman organisms would suggest implications beyond the debate concerning the underlying processes that result in perceived control effects in humans. If performance is affected by the manipulations of these experiments, and if no factor other than choice can be implicated as producing the effects, then the data would suggest that the rhesus monkeys of the present investigation may perceive the control that they have been given.

Before one can examine whether choice has an effect on performance, it must be demonstrated that the choosing is meaningful. That is, one must confirm that the subjects are indeed making choices and not simply responding randomly or in a fixed pattern of conditional contingencies in a way that appears to involve choices. There are at least three basic ways to ascertain that a subject is making meaningful choices (i.e., understands the demands of the tasks and the icon-task associations). These three methods (stability, paired-comparisons, and new icons) were used in Experiments 1–3, representing an effort to document that meaningful choices were made by the rhesus. Experiment 4 was a systematic exploration of the effects that these choices had on performance.

General Method

Subjects

Two 7-year-old male rhesus monkeys (*Macaca mulatta*; Abel and Baker) served as subjects for this investigation. They were neither food nor fluid deprived and were unrestrained within their home cages throughout the study. Each animal was highly skilled in responding to computer-generated stimuli by manipulating a joystick, and both animals had received a variety of training and testing prior to this experiment, including extensive experience on each of the tasks used in this investigation.

Apparatus

The animals were tested using the Language Research Center's Computerized Test System (LRC-CTS; Rumbaugh, Richardson, Washburn, Savage-Rumbaugh, & Hopkins, 1989). The basic system consists of a joystick connected to a Zenith Z-159 computer. All stimuli used in this experiment were computer-generated graphics presented on a 13-in. color monitor. Fruit-flavored 97-mg chow pellets (Noyes, Lancaster, New Hampshire) were dispensed automatically as nutritive reinforcers through a MetraByte (Taunton, Massachusetts) interface (PIO-12). Sound feedback, generated through an external speaker-amplifier located on top of the monitor, was also provided by the computer.

Tasks

The basic software platform for the present investigation was the SELECT task. In the SELECT task, a menu of five task options was presented to each of the subjects. Five icons, each representing a task from the animal's repertoire, were presented in random position on the screen, accompanied by a cursor (a "+" approximately 1-cm square) positioned midscreen. A sample screen configuration from the SELECT task is depicted in Figure 1. Selection of one of the options by moving the cursor (using the joystick) was recorded as a response. Choosing one of the icons resulted in the administration of five trials of the corresponding task, each separated by a 5-s intertrial interval. Following the fifth trial of the chosen task, the SELECT menu was again presented for subsequent selections.

Five tasks were used in conjunction with SELECT in this experiment. Each task corresponded to one of the options depicted on a SELECT menu screen (see Figure 1), and each task had been extensively used in experimental investigations prior to the present study. Consequently, detailed descriptions of each task are available elsewhere (Rumbaugh et al., 1989; Washburn, Hopkins, & Rumbaugh, 1989, 1990).

The SIDE task required each subject to bring the cursor (a white computer-graphics "ball", 2.5-cm diameter) into contact with the target through manipulation of the joystick. The target was a 2.5-cm stationary square located on one random selected border of the screen. Response time, the time from trial onset until the target is contacted,

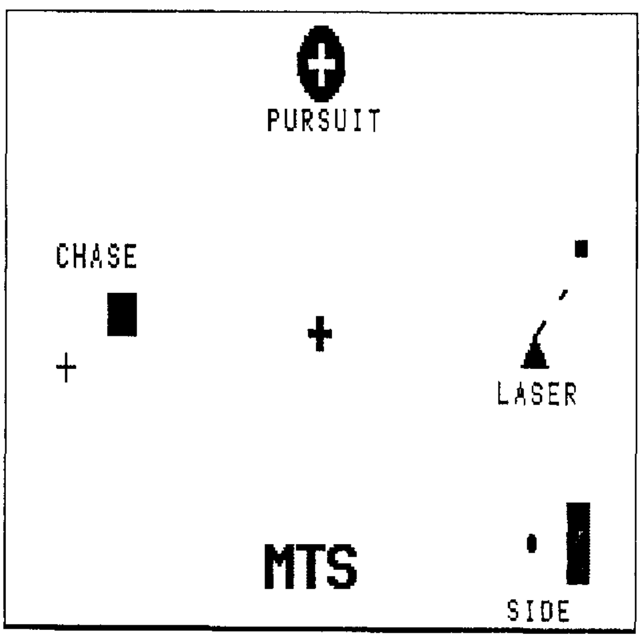

Figure 1. A sample screen from the SELECT task: The cursor, presented midscreen, amid randomly positioned task icons.

was measured, and each contact with the border of the screen (i.e., each occasion in which the cursor "missed" the target) was recorded as an error.

The CHASE task differed in that the target moved on the screen in a sawtooth pattern (i.e., reflecting off the borders of the computer screen at 45° angles) as the cursor moved. The target remained stationary when the cursor was stationary (e.g., when the animals were not manipulating the joystick). Consequently, the subjects were required to "chase and catch" the target by manipulation of the joystick. Although errors are not possible in this task, response latency and response time (the time between trial onset and the initiation of a response and the time between response initiation and trial termination, respectively), both subsumed in one measure in the SIDE task, were recorded separately in the CHASE task.

The PURSUIT tracking task was similar to CHASE, except the target (a 5-cm diameter white ball) moved independently of cursor movement once a collision had been detected. Thus, the subjects were required to maintain contact between the cursor and the moving target (i.e., to engage in pursuit tracking) for 3 s. Errors were recorded whenever the cursor was allowed to move outside the circumference of the target. Likewise, response latency and time were measured.

The LASER task was quite different from those previously described. Rather than moving a cursor to the target, LASER required that subjects "shoot at" the target as it moved back and forth across the screen. Manipulation of the joystick caused a "shot" of light to fire at a corresponding angle from a stationary computer-graphic turret (a 2.5-cm triangle, centered on the bottom border of the screen). This task supported the collection of a number of dependent variables, including accuracy (the number of shots taken to hit the target), response time, and response latency.

A matching-to-sample (MTS) paradigm was also used. In the MTS task, a computer-generated sample (e.g., an arbitrarily selected figure, alphanumeric character, random pattern) was presented on the screen, to which the subject moved the cursor by manipulating the joystick. On collision, the sample disappeared, and two choice stimuli were immediately presented. Reinforcement was obtained by appropriately matching the sample stimulus, that is, by bringing the cursor into contact with the choice stimulus that was identical to the sample. In addition to measures of accuracy, response latency and response time were recorded for each trial.

Procedure

Testing in the video-task paradigm is a subject-paced procedure. The computers were started by timer each morning and availed response opportunities to the animals for the duration of a session (9 hr). Within that period, the tasks described above were continuously available and subjects worked ad lib throughout the day. Appropriate completion of a trial was reinforced with a single 300-mg pellet, and each trial was separated by a 5-s intertrial interval. Under these conditions, approximately 600 trials per day were produced by each of the animals.

Training

Only the SELECT task was new to the subjects when this study began. No special training or shaping was used to introduce the SELECT task. Rather, the task was administered to the subjects as described above, with all five task options available. Of course, the task icons were completely novel to the animals at that time, but the cursor was identical in form to that used in previous tasks. Given the animals' previous training, they consequently manipulated the joystick so as to bring the cursor into contact with one of the icons, whereupon the corresponding task was presented.

A total of 700 SELECT trials (i.e., opportunities to choose a task) were collected from each of the animals, each permitting the subject to work on its chosen task for 5 trials. Responses on early SELECT trials were essentially random, but reliable response patterns were manifest with further experience. For both animals, SIDE was most frequently selected (the mean percentage of trials in which SIDE was selected, averaged across animals for the final 350 trials of training, was 65.0%), followed by CHASE (15.7%), LASER (7.9%), MTS (7.1%), and PURSUIT (4.3%).

Experiment 1: Day-to-Day Stability

The SELECT task was administered as described above for 10 days, resulting in 1,000 additional SELECT trials for each animal. These data were analyzed for daily task preference patterns by rank ordering the proportions of SELECT trials in which each task was chosen by each animal. A rank-order correlation coefficient was then computed for each of the subjects using preference patterns from each pair of consecutive days. For both animals, the correspondence of task preference patterns between days was very high (r = .945 and .890 for Abel and Baker, respectively). The only variability in the preference patterns across days was observed for the LASER and MTS tasks, which were approximately equally preferred. As with the previous data, the SIDE and CHASE tasks were most and second-most frequently selected, respectively, and the PURSUIT task was selected least frequently.

Experiment 2: Paired-Comparisons

To test further the stability and meaningfulness of these patterns, the SELECT task was altered in Experiment 2. In this study, only two options were available for each SELECT trial. Thus, each animal was required to choose between but two tasks. The 10 possible permutations of task pairings were administered in random order, with each pairing of tasks (e.g., SIDE–CHASE, LASER–PURSUIT) presented for a block of 50 SELECT trials.

The subjects selected the task that had previously been determined as "relatively preferred" more frequently than the relatively less-preferred task on the vast majority of SELECT trials (M[Abel] = 80.0%; M[Baker] = 73.0%). However, the observed probability of choosing a particular task was observed to be a function of relative preference, as can be seen in Table 1. Thus, there was a gradient of relative task preference for the 2 animals. Notwithstanding, the data strongly support the patterns observed previously and lend added credence to the contention that the monkeys chose a particular icon to gain access to a particular task.

Experiment 3: Introduction of New Icons

A final test of this issue was administered in Experiment 3. For this study, five icons were again presented on each SELECT trial, as in Experiment 1. However, the set of icons

Table 1
Experiment 2. Mean Percentage of Trials in Which a Particular Task Was Selected as a Function of the Alternative in Paired-Task Testing

Task chosen	Other task present				
	SIDE	CHASE	LASER	MTS	PURSUIT
			ABEL		
SIDE	—	62	82	88	94
CHASE	38	—	74	78	80
LASER	18	26	—	56	64
MTS	12	22	44	—	64
PURSUIT	6	20	36	36	—
			BAKER		
SIDE	—	52	82	88	82
CHASE	48	—	68	78	80
LASER	18	32	—	58	76
MTS	12	22	42	—	76
PURSUIT	18	20	24	24	—

Note. MTS = matching-to-sample.

depicted in Figure 1 were not used in this investigation. Rather, a new icon set was constructed and presented to the monkeys. The first letter of each task name was used as the icon for each task (e.g., S = SIDE, M = MTS). Each block-print letter measured approximately 2.5 × 2.5 cm, and each was positioned randomly on-screen as in previous experiments.

Consequently, the animals were required to learn new icons for each task. This manipulation was of interest for two reasons. Primarily, it seemed reasonable to hypothesize that task preference patterns for the selection of these new icons should match the patterns from previous experiments if indeed the selections were meaningfully interpretable. Additionally, we were interested in ascertaining whether the new icons, which bore no resemblance to the tasks themselves as did the tokens depicted in Figure 1, would present an additional learning challenge to the animals.

Each animal produced 700 SELECT trials in this experiment. The results of this manipulation can be summarized succinctly. The order of task preference, as indicated by the percentage of SELECT trials in which a particular task was chosen (over the terminal 350 trials), matched exactly that of the previous studies. The SIDE icon was selected the majority of the time (70.2%), followed by the CHASE (15.0%), LASER (6.8%), MTS (6.1%), and PURSUIT (1.9%) symbols.

Experiment 4

It was observed during the course of these experiments that performance on the selected tasks themselves rivaled or exceeded performance levels on identical tasks when used in other experiments (e.g., Rumbaugh et al., 1989; Washburn et al., 1989). This improvement in performance, if stable and significant, might have reflected an advantage afforded by choice and perceived control, as has been reported and discussed above. Alternatively, enhanced performance might have resulted from practice or other experiential factors. The necessary data for making this judgment were unavailable, however, as comparable control sessions of SIDE, CHASE, and so forth were not administered concurrent with the use of the SELECT task. Consequently, an experiment was undertaken to assay the effects of choice on performance.

Method

The icon set depicted in Figure 1 was again used in this investigation. Prior to the onset of Experiment 4, 200 SELECT trials were administered to each of the animals to reacquaint the subjects with these icons. Preference patterns on these trials matched those produced in previous experiments.

The animals were subsequently tested in three 3-hr sessions daily in an alternating (ABAB) design. On half of the sessions, the animals were given the SELECT task and allowed to work on tasks of their choosing, as described above. Both the order of task selection and the levels of performance on each of the selected tasks were recorded for subsequent analysis. On alternate sessions, tasks were assigned to the animals in five-trial blocks, again with the collection of performance data. The assignment of tasks was yoked to the previous SELECT-task block such that the order in which tasks were assigned and the within-session variety of tasks was constant between SELECT (SEL) sessions and assigned, or nonselection (NSEL), sessions. For instance, if the first three tasks an animal chose in a SEL session were SIDE, CHASE, and SIDE, then the first three tasks assigned in the subsequent NSEL session were SIDE, CHASE, and SIDE. The only difference between the SEL and NSEL conditions, then, was the opportunity to select the order of tasks.

By alternating the SEL and NSEL conditions in three sessions per day, factors such as time of day and fatigue were counterbalanced; the schedule of conditions was SEL-NSEL-SEL on the first day, NSEL-SEL-NSEL on the second day, and so forth. The NSEL condition always followed a SEL condition (albeit frequently from the previous day) so that the assignment of tasks would be appropriately yoked.

Note that the animals were not forced to work in either condition—as in the traditional, session-based, work-on-command model of comparative research—except in that food was only available during the day by undertaking the video tasks. Even here, however, it should be noted that both animals were given a supplemental feeding at day's end in excess of nutritional requirements, and portions of this feeding frequently remained available into the subsequent day's test session. By environmental enrichment standards, the task administration in both types of sessions was high in choice and freedom, as each animal worked essentially ad lib within the 9-hr test day. Frequently a task would be assigned on which the animals would delay working; however, subsequent tasks in the present study were never available until five trials of a task were produced. Notwithstanding, the animals could choose when to work in both conditions; in SEL sessions, the animals could additionally choose on what to work.

Use of this experimental procedure yielded a rich array of data. In addition to task preference patterns as a dependent variable, the measures of accuracy, latency, and response speed, which exist in each of the selectable tasks, were recorded. Thus, data were available for what the animals chose to work on and for how well the animals worked on each task, whether or not the task was chosen.

Results

In the 10 days of this study, Abel performed 978 SELECT trials (each involving a block of 5 task trials, half of which were selected and half assigned), whereas Baker produced 718 SELECT trials. Performance measures were averaged across animals and tasks. Mean accuracy levels on tasks in which the measure was available (SIDE, MTS, and PURSUIT) were 92.2% in the SEL condition and 86.2% in the NSEL condition. Median latency data from CHASE, PURSUIT, and LASER (the tasks in which latency was assessed) also favored selected versus assigned trials, $Md = 0.37$ s versus 0.62 s, respectively. Likewise, median response times, averaged across the tasks in which they were obtained (SIDE, CHASE, MTS, PURSUIT, and LASER) were $M(\text{SEL}) = 2.39$ s and $M(\text{NSEL}) = 2.74$ s.

Grouped tests of statistical significance for performance levels on each of these measures, averaged across animals or tasks, were deemed inappropriate, owing to differences between tasks in terms of procedure, number of trials, and variability. Rather, direct statistical comparison of performance levels for each individual animal on each task was performed. These statistics are reported in Table 2. For those comparisons in which performance levels differed at all, performance in the SEL condition significantly exceeded levels on identical tasks in the NSEL condition.

General Discussion

Both the magnitude and the robustness, across tasks and animals, of the effects of choice on task performance are noteworthy. The rhesus monkeys of the present investigation reliably performed better on a task if they chose the task on which to work, rather than if the task was assigned to them. These results, which at least in their magnitude were somewhat unexpected, are held to have direct implications for issues of perceived control in humans and, as will be seen, in nonhuman primates.

Least surprising of these data are the significant effects of choice on response latency; in fact, it is surprising that these effects were not more robust. One would predict that relatively little time would elapse from trial onset to the beginning of a response for an animal in the SEL condition simply on the knowledge that, to make the SELECT choice that initiated each block of trials, the animal had to be at the joystick. In contrast, an animal might have been anywhere in the cage and might have been engaged in any number of activities (e.g., grooming, drinking, or resting) when an assigned block of trials was initiated. Thus, the significant advantage of choice on latency revealed in the data for CHASE, LASER, and even SIDE (for which response time and response latency were unavailable as separate measures) may primarily reflect a performance advantage that results from allowing a subject to make a trial-initiation ("ready") response.

However, the significant advantage for selected versus assigned blocks of trials evinced in the response time data clearly suggests that the "trial preparedness" factor captures relatively little of the overall effect. Response time measurement did not begin on any trial in any condition until the joystick was moved. Notwithstanding, the time to contact the target stimulus in CHASE and LASER was significantly less in selected versus assigned blocks of trials, over and above the difference in latency values. These data, together with the data for SIDE, indicate that choice produces significant effects on performance even when the animals are equally prepared to respond across conditions.

The most unexpected of these findings, however, were the effects of control on the accuracy of responding. Although Monty and Perlmuter (1975) reported enhanced accuracy in a paired-associates learning task by humans, it is somewhat surprising that comparable effects were obtained with relatively simple task demands such as pursuit tracking and matching-to-sample. Yet the performance values obtained in these tasks in the SEL condition were substantially better than performance in the NSEL condition. These latter values were, in turn, essentially comparable across tasks to performance

Table 2
Experiment 4. Subject × Task × Measure Results

		ABEL				BAKER			
TASK	MEASURE	SEL	NSEL	t	df[a]	SEL	NSEL	t	df[a]
SIDE	% correct	89%	90%	0.61	301	82%	80%	0.98	176
SIDE	RT	1.45	2.10	3.27**	301	1.75	2.36	2.99**	176
CHASE	RLAT	0.58	0.77	1.67	71	0.77	1.44	2.98**	60
CHASE	RT	1.17	1.53	5.15**	71	1.20	1.58	2.57**	60
MTS	% correct	98%	90%	5.10**	39	95%	86%	3.30**	35
MTS	RT	1.82	1.78	0.51	39	1.80	1.92	1.12	35
PURSUIT	% correct	97%	92%	1.76	27	92%	79%	3.38**	26
PURSUIT	MEs/trial	1.02	1.12	2.22*	27	1.11	1.34	2.58**	26
PURSUIT	RLAT	0.26	0.70	1.19	27	0.31	0.36	0.63	26
PURSUIT	RT	5.25	5.35	0.80	27	5.69	6.05	1.69	26
LASER	RLAT	0.11	0.17	0.41	46	0.18	0.37	3.19**	57
LASER	RT	1.99	2.83	2.08*	46	1.78	2.73	4.14**	57
LASER	# of shots	3.11	3.61	3.21*	46	3.18	3.87	4.82**	57

Note. SEL = SELECT sessions; NSEL = assigned (nonselection) sessions; RT = response time (i.e., the median time, in seconds, from the beginning of a response to the termination of a trial); RLAT = response latency (i.e., the median time, in seconds, from the onset of a trial to the beginning of a response); MEs = mean number of errors.
[a] df = degrees of freedom, $N - 1$, where N equals the number of five-trial blocks available for the analysis.
* $p < .05$. ** $p < .01$.

values reported elsewhere for these animals (Rumbaugh et al., 1989; Washburn et al., 1989, 1990).

Together, these effects support the hypothesis that, as with humans, choice can produce significant improvement in performance in nonhuman primates. We contend, based on the stability of preference patterns produced by both animals in these experiments, that the animals were able to discriminate each of the icons and the tasks that they signaled. That is, the animals selected the SIDE icon with the "expectation" that the SIDE task would ensue, and so forth for each task. Moreover, the significant improvement in task performance produced under conditions of choice appear not to be attributable to some other nonchoice factor. Thus, it seems reasonable to infer that the rhesus detected the availability of choices, or perceived (at least in a limited sense) control. In other words, not only did the monkeys discriminate each of the choices, the animals were able to discern that they in fact had choices. This may be an integral component to what it means to be an intelligent organism (Rumbaugh & Sterritt, 1986).

Of course, attributing to rhesus monkeys the perception of control is inferential; we contend, however, that it is not anthropomorphic. Whereas human subjects can verbally report their perceptions, performance advantages under choice conditions in the present study constitute, in effect, a means of self-report for our subjects. Thus, the differences reported here are interpreted as reflective of each animal's willingness to work on specific tasks at specific times. They underscore the importance of environmental control and choice as choice in the behavior of rhesus monkeys, as with humans.

The specific mediating mechanisms of performance enhancement, whether they are motivational, attentional, or of some other nature, require further investigation. However, as was suggested earlier, the data delimit the hypothesis proffered by Burger (1987, 1989) that self-presentation concerns underlie perceived control effects. One cannot deny the influence of self-presentation on human performance, but parsimony suggests that a more basic process, one to which a variety of (at least) primate species are sensitive, is responsible for the effects of control on performance.

One potential explanation for these findings can be offered. Despite substantial ambiguity regarding the precise definition of psychological well-being for nonhuman primates, many researchers agree that choice and environmental control are crucial factors in the well-being and enrichment of a variety of captive species (e.g., Segal, 1989; Snowdon & Savage, 1989). One might then suggest that each of the animals in the present study are relatively enriched in that their well-being should be supported by conditions of choice. Although systematic measures of well-being were not taken in this investigation, informal observations of the monkeys and their behavior supports this contention. We suspect that sensitive measures of performance will reflect the psychological fitness of an organism across time, providing converging data to the other indices of psychological well-being (Novak & Suomi, 1988). In the light of this, it seems reasonable to contend that the significant advantage for performance under conditions of control stems in part from general improvement in the "wellness"—psychological if not also physical—of the captive primate subjects. In other words, quantitatively better data may be obtained under these conditions because the animals doing the responding are themselves qualitatively better. Specific experimentation is underway to elucidate further this possibility.

Another example of the enrichment value of these tasks are the preference patterns, depicted in Table 1. As was previously mentioned, these preference patterns are characteristic for each animal and have been relatively stable across the history of the SELECT task despite changes in icons. The most preferred tasks are clearly the easiest; they are also the first tasks learned by each animal. Although it is impossible to disambiguate fully the factors that make one task preferred over others, it is interesting and informative that the animals do not simply choose the easiest or most favored task exclusively. The distribution of task choices is skewed, but relatively nonpreferred and difficult tasks do occasionally get selected. It is unlikely that the selection of these relatively nonpreferred tasks reflects error or chance variability. Not only do the skill levels of each of the animals oppose this possibility, but it is also the case that performance on these relatively nonpreferred tasks when selected is enhanced over baseline levels, just as is the case with preferred tasks. The animals do occasionally elect to engage in more challenging and less preferred tasks.

There may be other substantial implications of these findings for issues of environmental enrichment of captive primates. Particularly when used with animal populations that are maintained for psychological and behavioral investigation, the video-task, menu-driven paradigm described here provides a data-rich and effort-efficient means of obtaining a variety of performance data while providing choices and environmental control at a number of levels. Whether or not continued study reveals choice of these tasks to be inherently motivating, it seems likely that the data produced and the well-being of the animals tested within this paradigm may be enhanced.

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