A Novel Training Technique To Remedy Common Husbandry Problems Of Socially Housed Monkeys

by

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Introduction

Enrichment programs for non-human primate research facilities are increasingly emphasizing the importance of naturalistic, species typical behavior. However, imitating natural conditions is difficult in laboratory settings. The need for social contact is especially hard to fulfill.

Many facilities pair house animals. While this is better than individual housing, it does not mimic the full range of physical contact of most species of primates, which typically live in large social groups. Group housing meets the five criteria for a successful enrichment program put forth by Young (2003). He suggests that enrichment programs should (1) increase behavioral diversity, (2) decrease abnormal behaviors, (3) increase the range and number of species typical behaviors, (4) increase the positive utilization of the environment and (5) increase the animals' ability to cope with stress in the environment. Group housed animals do exhibit less abnormal behavior than either pair housed or singly housed animals (Shapiro, 1996) and they exhibit a similar pattern of behavior to their natural counterparts (Schultz, 2005). It can be logically assumed that animals in a group enclosure instead of a single or pair cage would have access to a larger space, increasing their utilization of physical space and their ability to retreat farther from a source of stress.

On the other hand, group housing increases the risk of aggression and injury among the animals (Kaplan et al, 1980; Reinhardt et al, 1986, Rolland, 1991) and decreases their immune response to various diarrhea-causing micro-organisms (Shapiro et al, 2000). Also, group housing can be especially impractical in a laboratory setting, because capturing the animals for procedures can be time-consuming and stressful for the monkeys and their caretakers. As a consequence, it is usually reserved for breeding colonies or for peer groups of young animals.
The pens at the Wisconsin National Primate Research Center (WNPRC) in recent years have been used to house juvenile rhesus monkeys. Every day the animals are coaxed with treats to move to one side of the pen while the other side is washed. To pass from one side to the other they must run through a 6 foot long tunnel with sliding doors on each end. When the group needs to be captured, the door at the far end of the tunnel is blocked and as many animals that can be enticed into the tunnel are caught and removed. Often only several animals can be caught without husbandry personnel entering the enclosure. Often more than half will have to be chased by experienced staff until they go into the tunnel. Sometimes, one or two animals may have to be caught by hand, because they will not enter the tunnel. Even though this process is always carried out using as little coercion as possible, the process is still based largely on fear and appears to be stressful for both the animals and humans involved.

Knowles et al. (1995) trained group-housed animals to leave their enclosure in an order that was based on the animals' social rank. While being much less stressful and chaotic for the animals after they were trained, the initial training was based on the urge to escape from human intruders in the pen. The authors say that the animals were "encouraged" to leave this side, but did not elaborate on the details.

The current study aimed to train the animals, using operant conditioning techniques, to leave the enclosure in an order that the staff determines. When successfully completed, each animal will have been trained to leave the enclosure when presented with a specific cue. To accomplish this, each animal is individually trained while in the pen to approach and touch a specific plastic cue-card that varied by shape and color. This behavior is then transferred to the outer portion of the enclosure where the animals are trained to come to their shape when it is presented at the tunnel. Once in the tunnel they can be closed in and removed from the group for husbandry procedures (weighing, physicals, treatments, etc.), making group housing more practical for veterinarians and researchers alike.

Methods

Lab Environment and Sample: The study subjects were housed in the four social pens at the Wisconsin National Primate Research Center, each consisting of two rooms measuring 10 feet long, 6.5 feet wide and 7.25 feet high. All pens were connected by a six-foot tunnel running
from the front of one pen to the front of the other pen, 10 inches wide and 16 inches high and one pen also had a 16 X 15.75 inch hole through the middle wall.

Forty-nine rhesus macaques were used in this study. Forty-six of these were juveniles ranging in age from 1 year to 2 years and 10 months. Of these, 12 were male and 37 were female. They were raised by their mothers and in some cases another cage partner until weaning. After weaning, at approximately 8 to 10 months after birth, juveniles lived in cages with one to three other peers until they were moved into the pens. The three other animals were adults age from 15 to 19 years, one male and two females. They had spent the majority of their lives in single or double cages and had been used in various research protocols.

Four groups were established in pens. The three adult monkeys lived as the sole adult in a group of juveniles; therefore, all but one group contained an adult. The four study groups had slightly different characteristics. Group 1 consisted of 5 males and 7 females, ranging in age from 1 year and 9 months to 2 years and 9 months. This group was the only group without an adult and it had a much less stable social structure. Fighting was more prevalent and often broke up training sessions. Group 2 consisted of 3 males and 7 juvenile females, ranging in age from 1 year and 8 months to 1 year and 10 months. A 19-year-old female was alpha of this group. This group was the most stable and had positive interactions with husbandry staff. As a result, fighting was less common and the animals were comfortable with the presence of the trainer. Group 3 consisted of 3 juvenile males and 6 females, ranging in ages from 2 years and 5 months to 2 years and 9 months. One 17-year-old male was alpha of this group. This group was also relatively stable, but had less positive interactions with husbandry staff. They had the least number of fights, but were very hard to train, as only about half would approach the trainer. This group was eventually dropped because progress was very slow. Both groups 2 and 3 had experienced some negative interactions with husbandry staff more than one year before the study and Group 3 was never able to fully recover their trust in any husbandry staff. Group 4 was formed mid-study and consisted of 15 juvenile females, ranging in age from 1 year to 1 year and 9 months, and one 15 year old adult female. This group was easy to interact with, but the adult was not well suited to living with a group of juveniles.

The pens contained multiple levels for perching, a swing, toys (Kongs, dental balls, etc.), a hanging mirror, a swinging log and tunnels for enrichment and environmental stimulation. Each pen was typically washed between 8:00 am and 11:00 am each day and then the monkeys
were fed immediately afterwards. Cleaning was accomplished by coaxing the animals to one pen with food rewards and washing the empty one; the animals were moved to the clean side and the second side was washed. Additionally, automatic flushers were used approximately every hour to rinse the floors. In the afternoons, the animals would receive fruit enrichment and be fed chow again. At least every two weeks the animals would also receive tactile enrichment (puzzle feeders) and TV. A radio was played every day. Water was obtained through automatic drinkers on the walls and ceiling.

**Materials:** The plastic shapes used for training signals were made with 0.18 inch thick acrylic plastic. Each shape consisted of two portions: a 7 inch outer portion and a 3 inch ilmer portion glued to the middle of the larger outer portion. The shapes were made in 6 colors: blue, green, yellow, red, black and white; and 3 shapes: triangle, circle and square. The same two colors were never doubled in the same shape symbol. Similar symbols (for example, two symbols with an outer white portion and an inner red portion) were avoided so as not to confuse the animals.

**Training method:** *Habituation* should precede any training that occurs in the group. This can be beneficial to both the animals and the trainer. It allows the animals time to get used to the trainer so that entry into their living space is not so intrusive and it allows the trainer time to learn their animals. The shapes can be presented to the animals at this time as well. Putting them in the group's feeding box/trough can allow the animals to touch and smell them. It is recommended that trainers know their animals by sight, because things can happen "quickly among animals in the group and tattoo, conventional identification markers (e.g., tattoo) may not be readily observable. The habituation may include time spent doing routine husbandry work with the group if the trainer is also the caretaker.

The training process was divided into two broad phases that can be further divided into eight steps, briefly outlined in Table 1. Phase 1 is In-Pen training, which includes the first six steps and involves training the animals to recognize and come to their shapes. Phase 2 is Out-of Pen training, which includes the last two steps and incorporates the behavior from Phase 1 to train the animals to come into the capturing tunnel.

The eight steps within Phase 1 more closely detail the operant conditioning process needed to reach the point where an animal willingly leaves a group enclosure on command. **Step 1** is to simply get the animal to take treats from the trainer while standing inside the pen. Some
animals need some time with this because they are either fearful of the human in their space or they are too subordinate to take the food in the presence of their dominant peers. **Step 2** is reached when the animal approaches the trainer to get a food reward. **Step 3** requires the animal to reach over the shape to take treats. During this step the shape is moved upwards so that the monkey unintentionally touches the shape while reaching for the treat. This shows that touching the shape does not hurt and eliminates some of the fear of the foreign object. **Step 4** requires that the animal touches its shape voluntarily. The most efficient way to teach the animal to do this is to show the animal a food reward and hide it just behind the shape. Most animals will eventually try to move the shape away so that they are able to get to the food. They are rewarded heavily the first few times this happens. Each time the shape is presented, the food is then held progressively farther away from the shape until the animal no longer needs a food cue to touch the shape. **Step 5** is reached when the animal is able to move to another location within the enclosure to touch the shape. During this step, the animals often start to over-generalize their knowledge and begin to touch all the shapes so **Step 6** is introduced to test the animals' ability to distinguish between shapes. This is done by holding up two shapes, one that is their own shape and one that is not identified as their shape, and rewarding for correct touches. This is repeated with different shapes until the monkey consistently chooses correctly. Whenever there is an incorrect touch it works best for the trainer to put the shapes down or behind the back for a few seconds so that the monkey would not continue to grab at either shape. Once the animal knows which shape is the one that it should respond to, the trainer starts working out of the pen. **Step 7** involves teaching the animal to touch its shape through the mesh front of the enclosure. If a dominant animal over-generalizes by not allowing a more submissive animal access to the shape, it works well to keep moving the shape toward the animal the shape is identified with. Either the submissive animal will touch the shape and can be rewarded or the dominant animal will tire of chasing the shape around. Eventually, all but the most determined animals learned to ignore shapes that are not identified with them. Each time a shape is presented, it is then moved closer and closer to the capturing tunnel until the shape is actually presented at the tunnel. **Step 8** is reached when the animal can be willingly closed inside the capture area.

If training is only needed for routine veterinary care (i.e. only one or two animals will need to be removed on any given day) then reaching **Step 8** should be sufficient. However, if all the animals need to be removed from the group at the same time, then a transport/jump box
should be slowly incorporated. Often when the rest of the group sees the first taken out with the transport box they will become much more reluctant to come out themselves. Step 9 is reached when the animals come out knowing that they will be put in the transport box. To accomplish this, the animals should be slowly habituated to the transport box. The most effective way of doing this is to keep it present during the entire training process, but if that is not possible it can be left with the animals throughout the day or overnight, eventually leaving it in their enclosure for this time will help even more. After the animals are coming into the capture area, the trainer should merely touch the transport then reward the animal for tolerating this action. Eventually, one can pick up the transport and bring it closer, until it is touching the door of the capture area. Finally, if the animal is still comfortable coming out, the door can be opened and the animal can be caught in the transport. Moving too quickly on Step 9 can cause a lot of regression, so small steps are recommended. On any day there may be animals in different stages of training. Usually the trainer must work on most or all of the stages with many different animals within the same group. Waiting until all animals pass into a single stage will slow the entire process down too much to be efficient for group training.

Results:

Group 1 consisted of 12 animals. Nine of these completed the in-pen phase of the training in an average of 3.56 days and 6 of these animals completed the out-of-pen phase in an average of 7.83 days. A total of 33 hours and 17 minutes were spent in training this group. However, most of this time was spent in developing an original training plan that did not work. Only 11 hours and 34 minutes were spent training this group on the described training process.

Group 2 consisted of 11 animals. All 11 completed the in-pen phase of the training in an average of 8.73 days and 7 animals completed the out-of-pen phase in an average of 20.29 days. 36 hours and 37 minutes were spent training this group. Of that time, 13 hours and 8 minutes were spent unsuccessfully attempting to train 4 animals to leave the enclosure to be held in the tunnel.

Group 3 consisted of 10 animals. After 11 days, only two animals had completed the in-pen phase of training. These animals trained in an average of 3 days. No animals successfully completed the out-of-pen phase. A total of 3 hours and 25 minutes were spent training these animals.
Group 4 consisted of 16 animals. 13 of these completed the in-pen phase in an average of 5.62 days and 10 animals completed the out-of-pen phase in an average of 8 days. Many animals in this group regressed after entering the tunnel for the first time. Unstable group dynamics are thought to be the cause of this. A total of 15 hours and 45 minutes were spent training this group.

Adults VS. Juveniles: All of the three adults completed the in-pen phase in an average of 4.33 days and 2 completed the out-of-pen phase in an average of 10 days. Of the 46 juveniles, 32 finished the in-pen phase in an average of 6.13 days and 21 finished the out-of-pen phase in an average of 12.14 days. Refer to table 1 for completion success rates and time to completion of the 8 specific stages.

Discussion

Two prominent issues need to be considered when looking at the differences between groups and why the training was effective or not; (1) social stability of groups and (2) trust in husbandry staff/trainers. Group 1 was the only group that did not have an adult living with it and while they had a positive husbandry experience, they were never able to establish a relaxed and stable dominance hierarchy. Although the hierarchy was fairly static, it was held in place only though forceful behavior by the top ranking animals. Group 4 had an adult, but the adult was not well suited for maintaining the structure of the group and did not interact well with the juveniles. This made it hard to work with small groups or individuals since fights would occur during the absence of specific animals. In both of these groups, aggression towards subordinates that received a food reward occurred often and was disruptive to the training sequence.

Groups 2 and 3 had experienced some negative interactions with former husbandry staff over a year ago. In spite of this, group 2 managed to grow comfortable with new staff and was able to interact well with the trainer and learn the training process. All of the animals in Group 2 were therefore able to complete the in-pen training stages and a little more than half of them were able to complete the out-of-pen training stages. Group 3, on the other hand, was never quite able to become comfortable with the trainer and was eventually dropped from the study for this reason. The largest obstacle to completing the training process in Groups 1 and 2 was overcoming the fear the animals had of entering the capturing tunnel to be shut inside. In the past, the animals had only ever been caught in this space to be handled for weights, physicals or
treatments. It is highly recommended that the animals are trained to habituate and enter the capturing space before they are ever actually caught there.

Overall, the training has emphasized the importance of both positive human staff to non-human primate interaction and group social stability for successful husbandry of laboratory primates. The groups with the most positive caretaker interaction were easier to work with, and the effects of a negative husbandry experience were long term. Animals in unstable groups trained well, but regression was much higher, because of aggression was much higher. Often, subordinate animals received punishment from dominant animals for taking rewards or for being separated from protective cohorts. Group 2 responded the best to the training described in this report. The efficiency in which these animals came into the tunnel was much higher and the rate of regression was much lower than it was for the other groups. This seemed to be due to the fact that this group had a very stable social structure, attributed in large part to an adult that was well suited for living with a group of juveniles, along with a stable long-term positive experience with a very interactive caregiver. Groups that have not experienced social instability or any negative situations with husbandry staff are likely to progress quickly through this training process with a high rate of success.
Table 1: Completion of Steps and Phases

<table>
<thead>
<tr>
<th>Step</th>
<th>Phase</th>
<th>Description</th>
<th>Animals that reached step</th>
<th>Avg. trainings to reach this step</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Takes treats</td>
<td>47 (95.92%)</td>
<td>1.62</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Approaches trainer</td>
<td>44 (89.80%)</td>
<td>2.43</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Reaches over the shape</td>
<td>42 (85.71%)</td>
<td>4.09</td>
</tr>
<tr>
<td>4</td>
<td>In-Pen Training Phase</td>
<td>Touches the shape</td>
<td>38 (77.55%)</td>
<td>4.66</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Relocates to touch the shape</td>
<td>35 (72.92%)</td>
<td>5.97</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Distinguishes between their own shape and another</td>
<td>23 (47.92%)</td>
<td>7.22</td>
</tr>
<tr>
<td>7</td>
<td>Out-of-Pen Training Phase</td>
<td>Touches the shape through the front wall of the enclosure</td>
<td>31 (64.58%)</td>
<td>8.77</td>
</tr>
<tr>
<td>8*</td>
<td></td>
<td>Can be shut in the capturing area when the shape is presented</td>
<td>23 (47.92%)</td>
<td>11.96</td>
</tr>
</tbody>
</table>

*Due to time constraints, Step 9 was only incorporated into the training of Group 2. Of these animals 3 of the 11 came out when the transport was present.


Schultz KK. 2005. A comparative study of juvenile rhesus macaques (*Macaca mulatta*) living in free-range, mixed age groups to those living in captive, peer only groups. unpublished.

